SCIENCE ABSTRACTS.

Section A.—PHYSICS.

SEPTEMBER 1904.

GENERAL PHYSICS.

2098. *Diameter of Molecules.* **J. Bernstein.** (Ann. d. Physik, 14. 1. pp. 172–176, May, 1904.)—Assuming that in Lippmann's electro-capillary apparatus the electro-capillary layer is made up by a layer of HgO which is reduced by H-ions to Hg, and equating the work done in moving the meniscus, with the chemical energy of the reaction, we find the quantity of HgO involved and thence the thickness of the molecular layer of HgO. This gives for the electrical "double layer" a thickness of about $6{\cdot}18 \times 10^{-7}$ mm., one-thirtieth the thickness of the thinnest soap-bubble, but much the same as the thickness (Oberbeck) of the thinnest electrolytic deposit of metal which can produce a maximum of polarisation. The thickness of the superficial tension layer is greater than that of the electrical double layer, and the radius of action of a molecule is about ten times its own radius. A. D.

2099. *Water-jets.* **P. E. Belas.** (Roy. Dublin Soc., Proc. 10. 22. pp. 203–209, May 12, 1904.)—Photographs of falling jets. Drops leave the falling column with their major axis horizontal. The larger drops vibrate, being lengthened and shortened vertically. A tuning-fork placed on the stand makes the jet break up sooner, and the succession of vibrating falling drops presents to the eye the appearance of a jet with a beautiful wavy outline. Each vibration of the tuning-fork throws off a drop, and these drops falling on a stretched membrane produce a tone. If two forks be used, the membrane gives out the difference-tone of the two forks. A fine jet projected almost vertically upwards ceases to break into spray when the tuning-fork is applied to the stand; and if the pitch of the fork be high the jet may break up into three streams of ascending droplets, revolving round one another. A. D.

2100. *Limits of Sensibility of Odours and Emanations.* **Berthelot.** (Comptes Rendus, 138. pp. 1249–1251, May 24, 1904.)—The author considers that for iodoform the limit of sensibility of the olfactory organ is about one-hundredth of a billionth of a gramme contained in 1 c.cm. of air. Assuming that the substance volatilises at such a rate that, collecting it in a vessel of 100 c.cm. capacity, the odour is noticeable in one hour, 1 gm. of iodoform would lose a billionth of a gm. per hour, or a little less than one-hundredth of a mgm. in a year. With musk the weight lost would be much less, possibly a thousand times so. W. H. SI.

2101. *Direct Method of Measuring Volume Elasticity.* **A. Mallock.** (Roy. Soc., Proc. 74. pp. 50–52, July 19, 1904.)—The coefficient of volume elasticity is usually obtained by the help of Poisson's ratio in an indirect manner. The author shows it is easy to use the following direct method: When a long, circular cylinder is acted on by internal fluid pressure, if the walls are very thin compared to the diameter of the cylinder, the stress in the material parallel to the axis is just half the stress at right angles to the axis in the tangent plane. Expressing the conditions of strain and stress in the walls of the cylinder, it is found that the alteration in the length of a cylinder caused by fluid pressure depends solely on the volume elasticity, and a simple formula can be obtained which with isotropic materials is $K = Pr/6te$, where P is the fluid pressure, r the radius and t the thickness of the wall, and e the alteration in dimensions. To apply this method it is merely necessary to mount a suitable length of tube of the material to be experimented on so that it can be subjected to internal strain by fluid pressure and the variation in length measured. The tube is mounted horizontally and is supported at two points by gymbal rings. One of these is held by a rocking support carrying a small reflecting prism having an index mark which is observed by a micrometer microscope with a $\frac{1}{6}$-in. objective. The only practical difficulty was due to the variation of the temperature of the room during the experiments, but it was found that the effect could be eliminated from the observations. The longitudinal extension was measured at 100, 200, 300, and 400 lbs. pressure per sq. in., and the extensions when corrected for temperature and plotted in terms of pressure lie on a straight line. The following results were obtained:—

	K in C.G.S. Units × 10^{11}
Seamless steel tube, hard	18·4
„ „ „ annealed	18·2
Solid drawn brass tube, hard	11·05
„ „ „ „ annealed	10·75
Solid drawn copper tube, hard	23
„ „ „ „ annealed	16·2

The case of copper is remarkable, for in its hard-drawn condition it extends less in the direction of the drawing than a similar tube of steel would when equally strained. W. W. H. G.

2102. *Separation of Solids in the Surface-layers of Solutions and Suspensions.* **W. Ramsden.** (Roy. Soc., Proc. 72. pp. 156–164, Aug. 14, 1903.)—The author finds that it is a common property of albuminoid solutions to form, more or less rapidly, at their surfaces, solid or very viscous skins, which can be collected in a purely mechanical way. Further, a large number of colloidal solutions of non-albuminoids, more or less fine suspensions and even solutions of crystalline bodies give similar separations of solid or very viscous matter. The same takes place at the surface of contact of liquids which, without being viscous, are capable of forming persistent emulsions. All the substances here considered have the common property of diminishing the surface tension of their solvent, the fundamental condition being the presence of a gas-surface. In some cases very thin skins were formed on solutions of 1 part of dissolved substance in a million of water. The skins are partly soluble and partly insoluble in water. The froth-bubbles obtained with albumin, saponin, &c., exhibit phenomena indicating that the skin of the bubble is, as a whole, inelastic and comparable with solid matter. Bubbles of a pure 0·01 per cent. solution of saponin break down into innumerable small rods of solid saponin, although water is able to dissolve 2,500 times as much as separates out. These facts explain various hitherto obscure phenomena, such as the formation of a skin on hot milk exposed to evaporation, the failure of proteids and other colloids in solution to pass through fine filters without considerable loss, &c. T. H. P.

2103. *Influence of Temperature on the Torsional Elasticity of an Invar Wire.* **A. Fornaro and C. E. Guye.** (Archives des Sciences, 17. pp. 597–619, June, 1904. Paper read before the Société de Physique de Genève, 1903.)—The following table contains the results obtained after heatings of 12 hours' duration. The method used was the comparison of two lengths of the same wire, by taking the time and number of oscillations between coincidences, one of the wires only being heated.

	Mean temperature, C.	$\delta = \frac{G' - G''}{G'}$
Initial	29°·68	—
After the first heating to 56°·1......	29°·69	0·000554
„ second „ 56°·5......	29°·71	0·000811
„ first „ 78°·8......	29°·72	0·001384
„ second „ 78°·5......	29°·74	0·001607
„ first „ 98°·9......	29°·72	0·002728
„ second „ 98°·8......	29°·72	0·003318

It was found that after the heating last mentioned in this table, a further treatment at 56° C. for 12 hours produced only very slight difference in the modulus. Assuming the modulus G to be the same for both wires initially, the following values of β in the relation $G_{t'} = G_t \left\{1 + \beta (t' - t)\right\}$ were found :—

t'.	β.
Between 29°·7 and 56°·4	+ 0·000595
„ 29°·7 and 78°·7	+ 0·000562
„ 29°·7 and 98°·9	+ 0·000565

F. R.

2104. *Alteration of Specific Gravity in Wire-drawing.* **G. W. A. Kahlbaum.** (Ann. d. Physik, 14. 3. pp. 578–589, July 12, 1904.)—The author refers to his previous researches on the alteration of specific gravity at very high pressures (Naturforsch. Gesell. Basel, Verh. 15. p. 17, 1903), in which it was shown that all metals, with the one exception of cadmium, show a return to a density lower than the original value, when pressures greater than 10,000 atmospheres are applied, although the density increases up to that point. He then describes further experiments in which the alteration in the molecular condition is produced by drawing the metal through a die, in the form of wire. Measurements of the sp. gr. of platinum wires specially prepared by Heräus, of Hanau, are then detailed with all the special precautions taken, illustrated by an example. From the platinum bar 6 mm. diam. three cylinders 32 mm. long, of weight 32 gm., were turned down and the sp. gr. measured. These cylinders were then sent to be rolled and forged in the usual manner into rods 3 mm. diam., 55 mm. long (about), and again the sp. gr. taken. The rods were then drawn into wires and the sp. gr. again taken, the same procedure being adopted with all the samples. The mean values for the sp. gr. obtained were as follows :—

	No. 1.	No. 2.	No. 3.
Platinum cylinder	21·2137	21·3060	21·1326
„ rod, rolled and forged..................	21·4314	21·4194	21·4144
„ wire 1 mm. diam. (cold drawn)......	21·4136	21·4226	21·4233
Same wire annealed 3 min. (white heat)	21·4314	21·4323	21·4324
Platinum wire 0·7 mm. diam. (cold drawn)...	21·4181	21·4157	broken
Same wire annealed 3 min.	21·4314	21·4315	21·4332
Platinum wire 0·4 mm. diam. (cold drawn) ...	21·4142	21·4147	21·4134
Same wire annealed 3 min.	21·4308	21·4310	21·4317

These confirm the author's former statement that after too great an applied pressure there is a return to the lower sp. gr., and the novel result that in strongly compressed wires the density is again increased by annealing is emphasised. A similar behaviour has been noticed in wires of chemically pure Pt, Pt + 10 per cent. Ir, Al, and Cu, also rolled Al sheet and commercial sheet zinc. Alteration of conductivity after annealing of cold-drawn wires of Pt, Pt-Ir, Al, and Cu has been observed. The work of Spring is referred to [see Abstract No. 1242 (1904)]. L. H. W.

2105. *On the Vibrations Set up in Molecules by Collisions.* **J. H. Jeans.** (Phil. Mag. 6. pp. 279–286, Aug., 1903.)—A molecule is supposed in this paper to be capable of motions of translation and of rotation about an axis, and also of small vibratory motions, which are supposed to be, and, if small enough, may be isochronous. If so, then in stationary motion of a system of molecules the ratio between the mean energy of the vibrations and the whole mean energy of the molecule must have attained a certain limit, or, if that limit be not attained, the system must be approaching that limit. It has been assumed on very great personal authority that the limit in question is Maxwell's law of equipartition. This, however, depends on a very precarious assumption, and probably represents a limiting case only. However that may be, the ratio tends to a limit. It has been pointed out by Watson that a very long time may be required before the limit is actually attained. And this result is obtained by the author on independent grounds in the present paper. He supposes molecule A before its encounter with B to be executing a free vibration $\phi = C\cos pt + D\sin pt$. The mutual force V between A and B, which acts during the encounter, sets up in A a new vibration, and the resultant is found from $\phi = (C - Y)\cos pt + (D + X)\sin pt$, X and Y being found from the equation $X + iY = \frac{1}{ap}\int_0^\tau Ve^{ipt}dt$, the limits of integration defining the encounter. That gives an increase of the square of the amplitude $X^2 + Y^2 - 2(CX - DY)$, and to find the average for all encounters, he neglects the free vibration coefficients C, D, and uses only $X^2 + Y^2$. The proof is then given that this quantity is so small that it would require an immense time, according to the accepted values of molecular speeds, &c., for any ordinary gas to appreciably affect the ratio of the energies. The paper ends with the discussion of collisions between molecular and free ions.

S. H. B.

2106. *Theory of Capillarity.* **G. Bakker.** (Zeitschr. Phys. Chem. 48. pp. 1–39, May 10, 1904.)—This is a treatise on the theory of capillarity *ab initio.* We must, as the writer shows in the first section, consider two distinct kinds of forces in a fluid, one the thermic pressure in the interior, which he says is a force per unit of surface, and is the same for *all* directions, the other representing the "cohesion," which depends on intermolecular forces having finite radius of action. And this, as subsequently shown, depends on direction in the capillary layer. The statement concerning thermic pressure appears to assume the well-known, but rather questionable, theorem that the forces on any molecule in the interior always mutually cancel each other, the distribution being always uniform, notwithstanding the mutually attractive forces between molecules. It is impossible to abstract in detail the work of so extensive a treatise, the writer's own summary of the results obtained is therefore followed: (1) The phenomena of capillarity necessitate the assumption of two different kinds of force, namely, cohesion and thermic pressure. The equation of state for a homogeneous phase expresses analytically the condition of equilibrium between these forces and the external forces. (2) In the calculation of the rise of the fluid in a capillary tube, and the downward pressure, it is unnecessary to consider Laplace's molecular pressure. (3) The surface tension is a consequence of the difference between the pressures parallel to and at right angles to the capillary layer. Its analytical expression is $\int_1^2 (p_1 - p_2)dh$, in which p_1 is vapour pressure, p_2 the pressure parallel to the surface. (4) This agrees with the result found by Laplace for the same constant H. The potential per unit volume in the capillary layer is in absolute value equal to the cohesion in a direction parallel to the surface. (6) The mean value of the potential stands in the same relation to the mean value of the density, as the potential to the density in homogeneous phase. (7) Laplace's H is equal to the difference between three times the work required to separate the mass elements of the capillary layer and the double of the virial of the attractive forces. (8) If the potential in the interior of a homogeneous phase is proportional to the density, and outside falls rapidly to a constant, it must have the form $-f\frac{e^{-q}}{r}$. (9) This potential satisfies the differential equation $\Delta^2 V = q^2 V + 4\pi f\rho$. Conversely a function which satisfies this equation can be regarded as potential of a mass of density ρ. (10) Analytical values are given for the cohesion at right angles to and parallel to the surface. (11) The value of the surface tension is $H = \frac{1}{4\pi f}\int_1^2 \left(\frac{dV}{dh}\right)^2 dh$. (12) Another expression is given for the surface tension in a particular case, and the differential equation for the potential in the capillary layer is given. [See also Abstract No. 12 (1904).]

S. H. B.

2107. *Effect of Small Oscillations in External Conditions on a System of Two Variables.* **P. Duhem.** (Comptes Rendus, 138. pp. 1313–1316, May 30, 1904.)—This is an extension to two variables, α, β, of the results obtained by the writer for one variable in various earlier papers, here cited, of which the latest appears in Abstract No. 1596 (1904). The systems in question are supposed to be affected by hysteresis and viscosity. If A, B denote the two external forces, D the dissipation function, the fundamental equations used are $2D = L\alpha^2 + 2M\alpha\beta + N\beta^2$, where L, M, N are functions of α, β, and of the temperature τ, and L, N are both positive, and $LN - M^2$ is positive. The viscosity forces are then $U = -\frac{dD}{d\alpha}$, $V = -\frac{dD}{d\beta}$. He obtains (α', β' denoting $\frac{d\alpha}{dt}$, $\frac{d\beta}{dt}$, &c.) $L\alpha'' + M\beta'' = P \quad M\alpha'' + N\beta'' = Q$, where P, Q are known in terms of α, β, T, A, B, and their derivation of the first order with respect to t. Reasoning from this result he finds three cases for consideration: (1) The two velocities α', β' change sign very frequently, and by consequence α, β change their values very slowly. (2) One of the two velocities, say β', changes sign very frequently, the other, α', retains the same sign for finite periods. The argument for this case follows closely that of the former paper [Abstract No. 1596 (1904).] (3) Each of the two velocities, α', β', retains the same sign for a finite period. This problem is to be further considered in another note. S. H. B.

2108. *Influence of Small Variations of External Force on a System Defined by Two Variables affected by Hysteresis and Viscosity.* **P. Duhem.** (Comptes Rendus, 138. pp. 1471–1473, June 13, 1904.)—In the preceding note of May 30 [see preceding Abstract], the author reserved for consideration the following problem: "A system is defined by two variables, α', β, affected with hysteresis. The temperature T, and the external forces A, B, undergo small variation, about the mean values T_0, A_0, B_0. It is given that the two velocities α', β' retain for a finite time the same sign. Do the small variations of temperature and external force influence sensibly the values of these velocities?" The author obtains in answer to this question the following result, as assumed but not rigorously proved, that, namely, α and β always differ but little from integrals of certain differential equations, which would define the time variations of the system if T, A, B had the constant values T_0, A_0, B_0. The motion is thus approximately the same as if these three quantities (supposed initially to be subject to small oscillations) were not subject to oscillation at all. This result, however, is subject to the condition that neither α nor β with hysteresis is nearly exempt from viscosity. If, therefore, he says, we consider, as Marchis and Chevallier have done, the influence of small oscillations of temperature or external force, on a system defined by two variables with hysteresis, we do not prove that the viscosity is negligible, but only that one of the two variables is very slightly affected by viscosity; the action of viscosity corresponding to the other may be considerable. S. H. B.

2109. *On the Ascertained Absence of Effects of Motion through Æther, in Relation to Constitution of Matter, and on the Fitzgerald-Lorentz Hypothesis.* **J. Larmor.** (Phil. Mag. 7. pp. 621–625, June, 1904. Paper communicated by the Physical Society.)—The writer notices the confirmation by Brace of a conclusion already given by Rayleigh, namely, that the motion of transparent solids through æther does not induce double refraction. This result is to be compared with the Nicholson-Morley result, that the earth's motion in space has apparently no optical effect up to the second order of the small quantity v/C, v being the velocity of the earth in space, C that of light. Brace infers from the phenomena the non-existence of any second order deformation of the solid due to its translation. The author maintains, on the other hand, that the phenomena are consistent with such deformation. He refers to Lorentz's theory given in "Æther and Matter," and his own analysis as showing that a system of molecules at rest may be made to correspond with the same system in motion by a change of the Maxwellian vectors (f, g, h) and (a, b, c), (f, g, h) becoming in the moving system—

$$\left(f, g - \frac{v}{4\pi C^2} c, h + \frac{v}{4\pi C^2} b\right),$$

and $(a, b + 4\pi vh, c - 4\pi vg)$. He deals with the criticism that has been made, namely, that on one hypothesis we explain the absence of optical results to the first order, and require another to explain it for the second order, and so on. The first hypothesis, he says, is merely that electricity is atomic, which he says is demonstrated by the facts known to Ampère and Faraday, referring to "Æther and Matter," p. 337. The second hypothesis is that matter is electrically constituted—or consists of electrons, which are on this theory merely singular points or knots in æther. So we have, according to the theory, to do not with two separate entities, matter and æther acting on each other, but only with æther, and all physical phenomena as a manifestation of it. He would exclude, however, from this generalisation the phenomena of vital growth. That is, I suppose, till we have learned to attribute to æther the necessary additional properties. Is it not a thing known to us by inference, whose conditions are that it is to supply a solution of all physical problems whatever? The author concludes with a reference to Sutherland's recent remarks on the magnetic effect of electric convection [see Abstract No. 1771 (1904)], and the action of a dielectric varnish announced by Crémieu and Pender. S. H. B.

2110. *Principles of Aerodynamics and their Application to Some Special Problems.* **M. Smoluchowski-Smolan.** (Phil. Mag. 7. pp. 667–681, June, 1904.)—The writer explains the great complication of the theory of aerodynamics, involving as it does thermodynamics as well as ordinary mechanics. The thermodynamics, he says, are contained in the equation due to Kirchhoff and Natanson—$\frac{Dp}{Dt} + kp \text{ div.} = (k-1)(\phi + \kappa\Delta^2\theta)$. Here k (Italian letter) denotes the ratio of the specific heats. In other respects familiarity with the notation on the part of the reader is assumed. Special results, derived from this equation, are pointed out. The general object of the paper is the application of the principle of similarity employed by Helmholtz and others. According to this principle we are to suppose the variables $x, y, z, u, v, w, t, \theta, p$ in their ordinary signification in the original system replaced in the similar system by $mx, my, mz, nu, nv, nw, m/n, h\theta, bp$, and the coefficients R, μ, κ by $R/a, \beta\mu, \gamma\kappa$. The coefficient k denoting the ratio of the specific heats must be the same in each of the two gases. To include the variability of viscosity and conductivity, he introduces $\beta h^\epsilon \mu$, $\gamma h^\epsilon \kappa$ instead of μ, κ, the constants generally employed, ϵ being another constant. To show the uses of the method of similarity, he discusses several examples, namely—(1) the resistance of air to moving bodies, as in experiments on pendulums. This resistance for very slow motions is proportional to the first, for greater speeds to the second, power of the velocity. Suppose we have found by experiment the relation between the resistance B and the linear dimensions κ, for similar bodies moving with the same velocity under pressure p_0 and temperature θ_0.

It is required to find the resistance under pressure p, that is, for linear dimensions xp/p_0 the resistance is $\phi(xp/p_0)$. Then the argument is that the dimension of resistance requires proportionality in the two cases to bn^2, or $\frac{1}{b}\left(n=\frac{1}{b}\right)$, and the required law is $f(x\,p)=\frac{p_0}{p}\,\phi\left(\frac{xp}{p_0}\right)$. That is, if when resistance is proportional to linear dimensions, $\phi(x)=ax$, we must infer that it is independent of pressure. If proportional to superficial dimensions, *i.e.*, to x^2, it must be proportional to pressure. Other cases discussed are what he calls the turbulent motions setting in when a certain limit of stability is passed. The experiments of Joule and Kelvin on the heating effect produced in wires forming thermoelectric couples; the flow of a gas through pipes and holes; the acoustical phenomena studied by Kohlrausch accompanying the rush of gas through a slit; also Lorenz's result concerning the heat given off per unit of surface by a vertical plane at temperature $T+\theta_0$, the surrounding gas being at temperature T. He concludes with considerations on the measurement of thermic conductivity in gases. S. H. B.

2111. *Possible Variation in the Solar Radiation and its Probable Effect on Terrestrial Temperature.* **S. P. Langley.** (Astrophys. Journ. 19. pp. 305–321, June, 1904.)—From the determinations made at the Smithsonian Astrophysical Observatory by the author and Abbot [see Abstract No. 1320 (1904)] it would result that, eliminating all sources of error, the solar constant—*i.e.*, the solar radiation if it were measured outside the earth's atmosphere—fell off by about 10 per cent. at the end of March, 1903; in Feb., 1904, it seemed to regain its former value, 2·25. If the earth has a mean temperature of 17° C., then such a fall in the radiation should lower the mean terrestrial temperature by 7·5° C. The Dekadenberichte der Deutschen Seewarte, for 89 stations distributed over the North Temperate Zone, United States, Europe, Asiatic Russia, show an actual mean diminution of the average temperature by 2° C.; at Continental stations the fall was much greater than this mean. The transparency of the atmosphere was low since 1902, but recovered partly during the last three months of 1903; volcanic dust may have caused the opacity, which was not due to water vapour. While it is difficult to conceive what influence, if not solar, could have produced this rapid fall of temperature extending over the whole zone for so long a period, the evidence as to any variation in the solar constant is not conclusive, but such a variation may not unreasonably be inferred. The absolute values of the solar constant are probably too low. H. B.

2112. *Dimensions of Deep-Sea Waves and their Relation to Meteorological and Geographical Conditions.* **V. Cornish.** (Nature, 70. pp. 210–211, June 30, 1904. Extracted from Geograph. Journ., May, 1904.)—A table showing the relation between the true velocity of the wind—recalculated in accordance with the modern reduction factor for the Beaufort numbers—in statute and geographical miles per hour and the height of the waves in feet, has been compiled from the tables of Desbois, Antoine, and Paris, based on observations made during forty years on French vessels (mostly small) in all oceans. In the seas, heights of 20 ft. are the average, 30 ft. the maximum; in the oceans, 30 and 45 ft. In round numbers the height of the wave in feet may be assumed to be half of the velocity of the wind in statute miles per hour. The development of large waves depends upon their opportunity of attaining greater lengths, and strong winds blow only for a short time or over a small space. According to T. Stevenson, considerable waves will not become the dominant form except with a fetch approaching 2,000 times the wave-length. The average velocity of advance of deep depressions from W.S.W. on our coasts is 25 knots; taking the gale of Dec. 22, 1894, with a 9-hours' blow, wind 64 miles per hour, that would give a length of fetch of 225 geographical miles and a wave height of 22·5 ft. An unusually long swell of 2,000 ft. wave-length, moving with a speed of 69 knots, would require a wind of higher velocity—which would hardly blow over more than a short strip of even a great cyclone—to be developed into the dominant wave-form. H. B.

2113. *General Circulation of the Atmosphere in Middle and Higher Latitudes.* **W. N. Shaw.** (Roy. Soc., Proc. 74. pp. 20–30, July 19, 1904.)—The investigations by the Meteorological Office of the trajectories of air by means of synoptic charts indicate that the paths of air of the cyclonic disturbances near the British Isles do not always originate in anti-cyclonic areas, but may skirt neighbouring high-pressure areas, sometimes traversing large belts along lines of latitude; further, that the air moving in the neighbourhood of a cyclonic depression does not always seek the nearest barometric minimum. The monthly wind charts of the South Atlantic also show that the anti-cyclonic areas are of the nature of stable masses, round which the winds circulate, rather than regions out of which the winds blow. The observations suggest that the anti-cyclonic areas of the Atlantic are far less the sources of air supply for travelling storms, and that the motion of the air in middle latitudes is more a passage round the pole in a general easterly direction, than is assumed. The paper deals particularly with the general circulation in January. On the surfaces the disturbances travel very irregularly. But the rotatory winds round local centres are characteristic only for the surface. Teisserenc de Bort's isobars for the 4,000 m. level show no isolated local depression areas, and suggest a general circumpolar circulation in accordance with Hildebrandsson's cloud observations, with a divergence in the Northern Hemisphere towards the north over the Pacific and Atlantic Oceans and back again to the south over the Continents. In the Southern Hemisphere the motions follow the lines of latitude more closely. The surface distribution of pressure is made up of the distribution at the 4,000 m. level, transmitted to the surface, and the pressure due to the weight of the stratum below 4,000 m. Plotting the differences between the surface distribution (Hann) and the 4,000 m. level (Bort) for the month of January, the author finds that the general trend of lines is the same in both cases, but that the gradient is reversed. That is to say, that the average distribution of pressure can be divided into two parts, neither of which shows the characteristics of local cyclonic distribution; the part due to the upper atmosphere favours a circulation to the east, the part due to the lower atmosphere favours a circulation to the west, both following roughly the average isotherms. The calculations into which the sine of the latitude enters are not applicable to the torrid zone in which the general upper drift is indeed to the west (Eliot's cloud observations for India). But they would account for the fact that easterly surface winds seem to be of comparatively low altitude, that there is a high-pressure area over the Antarctic Continent (J. Murray), and that the winds of the South Atlantic run tangentially to the coast line. H. B.

2114. *Daily Periodic Changes in the Level of Artesian Wells in Japan.* **K. Honda.** (Mathematical and Physical Soc., Tokyo, 2. 6. pp. 65–73, 1903, and 2. 9. pp. 123–127, 1904.)—The author has continued Nakamura's observations of an artesian well in Tokyo University, 3 km. from the sea, 380 m. deep, built up of iron tubes 14 cm. in diam.; the ground is 15 m. above sea-level, the water-head 3 m. below the surface. The zinc float, recording on a vertical drum 9 cm. in diam., revolving once in a week, has been used by Yoshida and the author also for studying seiches. The water-level has 2 maxima and 2 minima in twenty-four hours, with a double amplitude of from 3 to 1 cm.; the fluctuations are particularly marked about new and full moons; high tide corresponds to high well-level. The author assumes that there is a porous layer containing gas underneath the well; high barometric pressure forces the water from the well into the cavities, a low barometer lets it flow back again; the tides have a similar but opposite effect. A closed jar was fitted over the mouth of the well; changing the air pressure artificially by 1 mm. of mercury in this jar, produced a change of 13·5 mm. in the water-level. Now as the air pressure acts both on the water and on the ground about the well, the observed change of 4·35 mm. in the water-head, corresponding to 1 mm. variation in the barometer, is a differential effect, representing 32 per cent. of the barometric fluctuations; thus the earth crust would transmit 68 per cent. of the barometer pressure on the surface to a depth of 380 m. From these considerations and the character of the curves—not reproduced—it would follow that the daily fluctuations in the water-level are essentially due to the tides, and not to the barometric variations; the tidal range in Tokyo is 1·5 m. The different character of the earth crust would explain why Omori finds that the maximum earthquake activity which generally coincides with high barometers is at some stations accompanied by low barometers. The well in Yokohama is 2 km. from the sea-coast, 2 m. above sea-level, 300 m. deep, the upper portion lined with iron tubes, 15 cm. in diam. As the well is constantly overflowing, a branch from the well was fitted into a mercury bottle. The level was found to be constantly rising in this branch during three months, at a gradually decreasing rate. The Yoshiwara well, 3·3 km. from the sea, is lined with bamboo, and only 24 m. deep; it is also overflowing, but its level did not rise. The Okubo well is at the foot of Mount Fuji, 6·4 km. from the sea, 230 m. above it; it has now a depth of 110 m., the boring being continued; the level is falling owing to the dry weather, which had no influence on the Tokyo well. The artificial pressure experiment was made in all the cases with the same result, and is to prove the existence of a porous layer or air space. It is proposed to investigate how far inland the influence of the tides on the well level extends. H. B.

2115. *Electric Equilibrium of the Sun.* **S. Arrhenius.** (Roy. Soc., Proc. 73. pp. 496–499, June 22, 1904.)—Granting the ionisation of the gaseous particles in the sun's atmosphere by the ultra-violet radiation, the observation of Wilson that negative ions condense vapours more easily than do positive ions, would lead to the conclusion that among the small drops formed by condensation in the sun's atmosphere far more are negatively charged than are positively charged. According to modern theory, these drops will then be driven away by the *pressure of radiation*, and will charge with negative electricity the atmospheres of the celestial bodies they encounter. This would go on until the charge becomes so great that discharges occur, when kathode rays will be formed, which will then carry the charge back to the universe. Then, assuming the particles to have a specific weight equal to that of water, and that the pressure of radiation is double that of the weight of the particles in the neighbourhood of the sun, the author calculates that the time necessary for the particle's passage from the surface of the sun to the earth will be about 68·7 hours. Applying the corrections due to the fact of the particles being neither perfectly reflecting nor perfectly black, this time of passage will be reduced to 46 hours. A comparison is next instituted between this time and that found by various authorities for the interval elapsing between the maximum of a magnetic storm or brilliant aurora and the instant of passage of a centre of solar disturbance over the sun's central meridian, and the similarity of the two periods is considered suggestive of a possible close connection between the two phenomena. A discussion follows of the various limiting distances at which returning negative electrons may or may not be captured by the sun, one of the determining factors of this being the degree of agglomeration of the original drops or particles, thereby varying the potential. C. P. B.

2116. *Radial Velocities of Brighter Stars in the Pleiades.* **W. S. Adams.** (Astrophys. Journ. 19. pp. 338–343, June, 1904.)—The chief difficulty with regard to this special group has been on account of their spectra being such that an efficient comparison spectrum was unavailable, the stars being of the transition type between "*helium*" stars and "*hydrogen metallic stars.*" On account of the lines being thin, a comparatively low dispersion was employed, the Bruce spectrograph being modified so as to use only one prism instead of the three generally used for radial velocity determinations. Six stars of the Pleiades group are included in the discussion, for all of which at least three plates have been obtained. A table is given showing the velocities determined, from which it appears that the radial motion of the star Maia is variable. C. P. B.

2117. *Photographs of Spectrum of Jupiter.* **Millochau.** (Comptes Rendus, 138. pp. 1477–1478; Remarks by **J. Janssen,** pp. 1478–1479, June 13, 1904.)—Several photographs of the spectrum of the planet Jupiter were obtained during December, 1903, and January, 1904, with the large refractor of the Meudon Observatory and a prism spectrograph. Good plates were got with exposures of about 90 min., the lunar spectrum being taken for comparison. The slit was oriented to three positions, parallel to the axis, parallel to the equator, and at 45° to these two. The spectra show clearly five bands of absorption special to the atmosphere of the planet, at λλ 618, 607, 600, 578, and 515, corresponding closely with similar bands photographed in the spectrum of Uranus by Keeler. In addition the bands of water vapour and the *a* group are strongly intensified. C. P. B.

REFERENCES.

2118. *Automatic Mercury Vacuum Pump.* **S. R. Milner.** (Phil. Mag. 6. pp. 316–322, Sept., 1903.)—The author has constructed a portable Toepler pump with improved head and means for expelling the last traces of air. The mercury vessel 30 cm. below the pump bulb is, by means of a three-way cock, worked electrically with the aid of solenoids, alternately connected with the atmosphere and with the water pump which exhausts the auxiliary chamber. In order to produce the occasional complete stroke—as distinct from the partial strokes—only when required, a gauge is added to the auxiliary chamber; in this gauge are two contacts joined to a small contact-breaker, the circuit being closed by the mercury column. H. B.

2119. *Automatic Mercury Cleaning Apparatus.* **A. Turpain.** (Soc. Franç. Phys., Séances, 2. pp. 65–67, 1904.)—The apparatus, made by Berlemont, consists of three cylindrical vessels, fitted vertically above one another, and underneath them the reservoir R. The bottoms of A, B, C are perforated and surmounted by hook-shaped siphons. A is charged with diluted nitric acid, B with sulphuric acid, C with caustic potash. The globules of mercury collecting in R are either drawn off or raised again up a vertical tube connected with a pump, to be repurified. The author has had one of these continuous apparatus, which can be left to itself for weeks, in use for two years. H. B.

2120. *New Anti-capillary Aerometer.* **N. Hesehus.** (Collection of Physical papers devoted to the memory of T. T. Petrouchewsky, pp. 36–41, 1904.)—The aerometer suggested by the author is based on the same principle as those of Laska (1889) and Van Aubel (1893), having the shape of the ordinary constant weight instrument. A distinctive feature, however, is the opening at the top of the tube, intended for pouring water into the apparatus, so as to have the same immersed into the liquid as far as the zero division, a metallic cap being placed above the instrument so as to immerse the same down to the division h. If in water under the same conditions the apparatus reads h_1, the required density of the liquid will be given by the relation $\delta = \delta_1 . h_1/h$. A. G.

2121. *United States Bureau of Standards.* **E. B. Rosa.** (Science, 19. pp. 937–949, June 24, 1904.)—This article contains a general description of the new Bureau of Standards of the U.S.A.—an institution similar to the National Physical Laboratory in Britain or the Physikalisch-Technische Reichsanstalt in Germany. The various departments are described. They are divided into three main sections or divisions. Division I., under the Director, S. W. Stratton, deals with (1) Weights and Measures, (2) Heat and Thermometry, (3) Light and Optical Instruments, (4) Engineering Instruments, (5) the Office, (6) the Instrument Shop. Division II., under the direction of Rosa, deals with (1) Resistance and Electromotive Force, (2) Magnetism and Absolute Measurement of Current, (3) Inductance and Capacity, (4) Electrical Measuring Instruments, (5) Photometry, (6) Engineering Plant. Division III., under the direction of W. A. Noyes, is to deal with the chemical investigations and tests. The equipment of the various departments and the tests which they are in a position to undertake are mentioned. J. B. H.

2122. *Hydrogen as Unit of Comparison in Determining the Specific Gravity of Gases.* **A. P. Lidoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1245–1246, 1903.)—The author's reasons for displacing air by hydrogen as a standard in gaseous specific gravity determinations are: (1) Hydrogen has a much smaller specific gravity than air, so that the differences between the specific gravities of different gases are more striking than where air is taken as standard. (2) Air is not an element, but a complex mixture of gases, and investigations by the author show that the proportion of nitrogen in the inert portion of the air varies by as much as 8 per cent. T. H. P

2123. *New Gravimetric Method of Determining the Specific Gravity of Gases.* **A. P. Lidoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1239–1245, 1903.)—The method here described for determining the specific gravity of gases is based on the absorption of many gases by heated magnesium or manganese; the volume of gas absorbed is measured by ordinary gasometric apparatus, and the increase in weight of the absorbing metal is also determined. With cyanogen (manganese) and with atmospheric and chemical nitrogen, carbon dioxide, nitrous oxide, sulphur dioxide, and ammonia (magnesium) the method gives good results. A sketch of the apparatus used is given. T. H. P

2124. *Duplex Horizontal Pendulum Apparatus.* **F. Omori.** (Mathematical and Physical Soc., Tokyo, 2. 8. pp. 118–119, 1904.)—A flat disc of lead, 50 kg. in weight, is suspended by diagonal wires and a horizontal pivoted strut. It is very nearly in neutral equilibrium, and further adjusted by an inverted pendulum, an aluminium tube whose disc of 0·1 kg. is next to the lead. Only a diagram of the portable instrument whose strut has a length of 1 m. is reproduced. [See also Abstract No. 28 (1904).] H. B.

2125. *Radial Area Scale.* **R. W. K. Edwards.** (Roy. Soc., Proc. 73. pp. 292–295, May 7, 1904.)—A description of a contrivance for finding the area of a plane figure by means of a transparency. The designs consist of a number of graduated radiating lines. J. W. P.

2126. *Graphical Process of Constructing Correct Curves from the Results of Experiment.* **V. Hensen.** (Gesell. Wiss. Göttingen, Nachr., Math.-phys. Klasse, 2. pp. 131–156, May 20, 1904.)—By means of an example the author shows how to draw a curve to represent a set of observations freed from their fallible errors, the curve being such that its co-ordinates increase together and the character of its curvature does not change. R. E. B.

2127. *Determining the Hardness of Bodies.* **V. Nélioubow.** (Collection of physical papers devoted to the memory of T. T. Petrouchewsky, pp. 63–69, 1904.)—In order to obtain the figure characteristic of the hardness of a body, the author measures the pressure per unit of contact surface in the impact of a sphere made of the material to be tested against a plate of the same material, calculating this pressure according to the variation of the speed and the duration of contact. To find the latter, the plate should be electrified before the experiment, and the sphere earthed. The duration of contact is evaluated according to the diminution of potential during the impact. The figures obtained by the author agree very closely with those given by Auerbach. [See Abstract No. 1 (1901).] A. G.

2128. *Stability of Equilibrium.* **P. Painlevé.** (Comptes Rendus, 138. pp. 1555–1557, June 20, 1904.)—A note questioning the universal validity of Dirichlet's theorem that every equilibrium position for which the forces are not a maximum is unstable. A simple mathematical illustration is given. J. W. P.

2129. *Critical Thickness of Solid and Liquid Films.* **H. Devaux.** (Journ. de Physique, 3. pp. 450–453, June, 1904.)—Values for this limiting thickness are found for olive oil, oleic acid, &c. Rayleigh's results are extended. The values are found for solids such as copper sulphide, silver iodide, &c. A correspondence with the diameter of the molecule is pointed out. J. W. P.

2130. *Respiration in Air Poor in Oxygen.* **J. Tissot.** (Comptes Rendus, 138. pp. 1454–1456, June 6, 1904.)—While Schumburg, Zuntz, Schroetter, and also Loewy observed an increased internal combustion on the top of Monte Rosa and in balloons, the author and Loewy found no such change in rarefied air, nor in balloons up to altitudes of 4,300 m. The author has now prepared homogeneous mixtures of nitrogen, containing from 21 down to 9·5 per cent. of oxygen at ordinary pressures. The respiration experiments with two men lasted about half an hour in each case. The pulmonary activity did not increase before the oxygen percentage in the artificial atmosphere went down to 11 (equivalent to an altitude of 5,000 m.); the amount of carbon dioxide exhaled also remained steady up to this point; the amount of oxygen absorbed was little affected even down to 9·5 per cent. of oxygen in the atmosphere (equivalent to an altitude of 6,500 m.). On exceeding the 11 per cent. limit the respiratory quotient rises considerably. H. B.

2131. *Propagation of Shocks in Gases.* **E. Jouguet.** (Comptes Rendus, 138. pp. 1685–1688, June 27, 1904.)—Quasi-waves of shock propagating a dilatation in accordance with Hugoniot's law cannot occur in a slightly viscous perfect gas; but, as a quasi-wave of shock moves, its speed varies, as Vieille has experimentally shown. R. E. B.

2132. *Use of Radium in Section-cutting.* **H. H. Dixon.** (Nature, 70. p. 198, June 30, 1904.)—The electrification which occurs on cutting microtome-sections of material embedded in paraffin wax may be avoided by fixing a 5 mgm. tube of radium bromide on the microtome-knife close to where the paraffin ribbon is forming. J. J. S.

2133. *Energy in Statical Actions.* **E. Lebert.** (Comptes Rendus, 138. pp. 1481–1483, June 13, 1904.)—A note to illustrate a correspondence between the energy applied and the resulting action in certain apparently statical cases; and application to muscular actions. J. W. P.

2134. *Muscular Energy.* **A. Chauveau.** (Comptes Rendus, 138. pp. 1669–1675, June 27, 1904.)—The subject was made to lift weights of 1·5, 3, 4, 5·6 kg. thirteen times a minute, moving the forearm through an angle of 20°, about 0·34 m. each time, and thus 4·4 m. in a minute. The internal energy expenditure seems to increase as the load, but less rapidly than the height to which the load is lifted. It should hence be more tiring to raise 5·6 kg. 4·4 m. within a minute, than to divide the load into four parts and lift each the whole height within 15 sec. [See Abstract No. 36 (1903).] H. B.

2135. *Distribution of Air Pressure and Cloudiness.* **F. M. Exner.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1667–1684, Dec., 1903.)—The author examines the distribution of air pressure at thirteen stations in Austria-Hungary which would, with west winds of certain strengths, produce certain degrees of cloudiness at Vienna. He selects days from twenty years' records (winter months, October to April), distinguishing winds of intensities 3, 4, 5 (or 6), and 12 degrees of cloudiness. Referring to his theory of vertical air-currents [See Abstract No. 17 (1904)], he arrives at the rule that bad weather will set in when air flows from an area with a high-pressure gradient to an area with a smaller gradient; and fine weather in the opposite case. In the former case, the excess of air escapes in an ascending current. Districts near the sea-shore and in the plains would be more suitable for this inquiry, which disregards level differences, than the mountainous neighbourhood of Vienna; the author finds a support for his views in some observations made on the shores of the North Sea. H. B.

2136. *Seiches on the Chiemsee.* **A. Endrös.** (Zeitschr. Instrumentenk. 24. pp. 180–181, June, 1904. From Dissertation, K. techn. Hochschule, München.)—Two Sarasin limnimeters were used and proved reliable, though the temperature of the blackened portions varied sometimes by 40° in the course of a day. The mechanism stuck a little occasionally, however. As very complicated curves were observed at the west and north ends of the lake, the author constructed a portable, easily-mounted limnimeter. The pen is directly attached to the float rod, and guided with its sleeve in a tube, with the aid of friction rollers taken from an arc lamp mechanism. Twelve kinds of oscillations have been observed. The chief oscillation has a period of 43·21 min.; its maximum amplitude was 30 cm.; the binodal seiche of 28·98 min. is equally frequent. There are further tri-nodal seiches of 15·8 and 7·0 min., still others of 11 and 8·2 min., and transversal oscillations of 18·2 and 5 min. Several seiches, up to 8, are always noticed simultaneously. Even under an ice crust, 30 cm. in thickness, oscillations of 26 mm. could generally be found. H. B.

2137. *Daily Air-Pressure Curve in Berlin.* **R. Börnstein.** (Deutsch. Phys. Gesell., Verh. 6. 11–12. pp. 193–194, misprint corrected p. 208, June 30, 1904. Paper read before the K. Akad. Wiss. Wien, May 13, 1904.)—An examination of the twenty years' records (1884 to 1903) obtained at the Agricultural College, with the Sprung-Fuess barograph, shows maxima at 10 a.m. and 11 p.m. and minima at 5 p.m. and 4 a.m., the first-mentioned extremes being more pronounced. The third maximum of Rykatschew can be observed in the early morning hours from November to February. From harmonic analyses Hann had concluded that the diurnal variation is closely connected with the temperature and local conditions, while the much stronger semi-diurnal variation seems to be independent of local influences. Working out a suggestion by Kelvin, Margules had found an oscillation of the whole atmosphere of the earth with a period of twelve hours. Analysing the temperature data for Berlin for the years 1890 to 1897 like the air-pressure data, the author finds that the semi-diurnal oscillation of the temperature takes the same course as the barometer oscillation, and it would therefore appear possible, in the case of Berlin at any rate, to regard the harmonic series as the mathematical expression of a single physical relation, the dependence of the air pressure upon the local temperature. H. B.

2138. *Oceanography of the Azores.* **Thoulet.** (Comptes Rendus, 138. pp. 1643–1644, June 20, 1904.)—The charts being prepared by the author after the explorations, conducted by the Prince of Monaco on board the *Hirondelle* and the *Princess Alice*, and by the Portuguese gunboat *Açor*, show that the seven eastern islands of the archipelago seem to form an immense crater, open on the southern side, from the bottom of which other peaks and craters rise. The charts mark by different colours the distribution of lime and of ammonia at the bottom and in the water, and the temperature at the bottom and at a depth of 1,000 m. [See also Abstract No. 997 (1904).] H. B.

2139. *Meteorology at the Franco-Scandinavian Station at Hald, Denmark.* **L. Teisserenc de Bort.** (Comptes Rendus, 138. pp. 1736–1737, June 27, 1904.)—The author points out a few of the results of the observations made from July, 1902, to May, 1903. Barometric depressions of small area cross frequently at Hald, near Viborg, and are announced by a return of the wind, first in the lower strata, to the south. Kites have been kept flying for 26 hours maximum; winds from S.E. to N.E. generally lose their force at a certain height, so markedly sometimes that the kite seems to be kept down by a ceiling. Powerful winds have repeatedly dropped so suddenly that the kite with its line has fallen from a height of more than 1,000 m. While on the whole the winter temperature at Hald is little colder than at Paris, on March 15, 1903, a balloon recorded —38° C. at Hald and —17° C. at Paris, both at the same elevations of 4,000 m; the day previous both the balloons recorded —16° C. at the same height, the difference in the surface temperatures being only 2°. The climates are more variable at certain heights than near the surface. H. B.

2140. *Synodic-Monthly Variation of Seismic Frequency in Japan.* **A. Imamura.** (Mathematical and Physical Soc., Tokyo, 2. 8. pp. 109–112, 1904.)—From the records of 7,000 earthquakes Knott [see Abstract No. 1633 (1899)] had concluded that earthquakes were most frequent at the times of conjunction and opposition of sun and moon, and least frequent at the times of quadrature. Excluding the after-shocks from the Catalogue of the Imperial Earthquake Commission, the author deals with the 1898 historical earthquakes and the 13,678 records of the Gray-Milne seismographs of twenty-two stations. Grouping these under the heads: A inland, B inland and submarine, C submarine earthquakes, the author finds that the A group has its frequency maximum on the days of opposition and conjunction, and that the C group is characterised by another pair of maximum frequency on the days of quadrature. In accordance with Honda and also Omori, the author suggests that the resultant influence of the variations in air pressure and in the tidal force would become most effective about the 7th and 22nd days of the synodic month. H. B.

2141. *Earthquake Frequency and Atmospheric Pressure.* **F. Omori.** (Mathematical and Physical Soc., Tokyo, 2. 8. pp. 113–117, 1904.)—The after-shocks of the great Mino-Owari earthquake of Oct. 28, 1891, continued up to the year 1903. The 1,488 after-shocks of the winter 1891–92 were least frequent on days of barometric maxima and minima. The 561 earthquakes of Utsunomiya of the years 1894 to 1902 were most frequent at barometric maxima and minima ; the same holds good for the Tokyo earthquakes of 1897 to 1903, and for the shocks and the underground sounds heard in the hot-spring district of Arima for several months after July, 1899. All these earthquakes were recorded by Gray-Milne seismographs. When the 251 small shocks, recorded at Tokyo only by the Omori horizontal pendulum, are considered, however, the frequency is highest for the times of barometric minimum. The author suggests that, according to the nature of the origin and the cause of earthquakes, the maximum seismic activity may be accompanied by a maximum, minimum, ascending or descending atmospheric pressure, but that there is a connection between the phenomena. H. B.

2142. *Determination of the Gravitation Constant at Spandau.* **E. Haupt** and **E. Take.** (Zeitschr. Instrumentenk. 24. pp. 185–186, June, 1904. Sitzungsber. Gesell. zur Beförderung d. ges. Naturw., Marburg, June, 1903.)—In their determination of the constant Krigar-Menzel, and Richarz [see Abstracts Nos. 232 (1899) and 1395 (1900)] had not considered the influence of terrestrial magnetism. C. Braun having drawn attention to this point, the authors examined the materials used, spheres of copper of 1 kg., hollow spheres of platinum of the same volume as the copper spheres, and a lead block of 100,000 kg., by comparing the copper with a mixture of very finely divided iron and gypsum as to magnetic susceptibility. In testing the platinum spheres, hollow and solid spheres of aluminium were further used as intermediate standards. It results that the magnetic effects may be neglected. It was found, however, that the foundations of the lead block rose by 0·074 cm. after removing the lead, but the correction required under this heading would also fall within the probable errors. The corrected values are $G = (6{\cdot}682 \pm 0{\cdot}011)\ 10^{-8}$ c.g.s. units, and earth density $\Delta = 5{\cdot}507 \pm 0{\cdot}009$. H. B.

2143. *Solar Photometry.* **A. Pochettino.** (Accad. Lincei, Atti, 12. pp. 152–158, Aug. 16, 1903.)—Experiments made with a potassium photo-electric cell instead of the eye. Maximum at noon or a little earlier. The fall about 2 p.m. is not as great as Bunsen and Roscoe made it out. At mountain heights the intensities are greater (on M. Rosa, 4,559 m., they are three or four times as great in the morning, twice as great at noon as they are at a height of 80 m.) ; but the curve during the day is not as symmetrical with respect to noon as it is at lower levels. A. D.

2144. *Sun-spots and Temperature.* **A. B. MacDowall.** (Nature, 69. pp. 607–608, April 28, 1904.)—The writer takes the plotted curves of the last five sun-spot periods, from 1844–1901, and compares them with curves prepared from the meteorological summaries at Greenwich during the same period. From the coincidence or otherwise of the various maxima and minima the writer finds that the time of greatest spot numbers was simultaneous with that of greatest warmth, and *vice versâ.* This is for temperate latitudes. From various other researches it would appear that the inverse is true of places in tropical regions, and the author invites opinions on the question. C. P. B.

2145. *Possible Long Period Variation of Radial Velocity.* **H. C. Lord.** (Astrophys. Journ. 19. pp. 246–250, May, 1904.)—Photographs of the spectrum of η Piscium taken at widely separated epochs show variations of radial velocity which it is possible may be indicative of real changes in the movement of the star. The measured velocities show a change from $+21{\cdot}9$ to $+12{\cdot}3$ km. per sec.—about 8·8 km. per sec.—in the period of two years, from 1901–1903. C. P. B.

LIGHT.

2146. *Extension of Airy's Rainbow Theory.* **K. Aichi** and **T. Tanakadate.** (Mathematical and Physical Soc., Tokyo, 2. 6. pp. 79–86, 1903.)—Airy's theory is based on the assumption of a *point source* of light. The sun having a finite angular diameter, it is evident that the rainbow as actually seen will slightly differ from that given by theory assuming a point source, and the present paper gives a discussion of the difference produced when the source is a circular disc. The authors conclude that whereas Airy's theory requires *numerous* supernumerary arcs, the corrected analysis indicates that these secondary rainbows will be reduced in number considerably, and several experiments were made apparently confirming this conclusion. C. P. B.

2147. *Theory of Radiation Pressure.* **M. Abraham.** (Ann. d. Physik, 14. 2. pp. 236–287, June, 1904.)—A highly mathematical treatise of radiation and radiation pressure in the light of the recent theories of electrons, and the thermodynamics of radiation from an absolutely black body. E. H. B.

2148. *Penetrating Rays in Interstellar Space?* **Elihu Thomson.** (Science, 18. pp. 337–338, Sept. 11, 1903.)—The idea is here advanced that possibly interstellar space is traversed not only by light and heat waves but also by rays of the more recently discovered penetrating kinds. Might they not come from matter moving with such very high velocities as are comparable with that of light? Assemblages of electrons on impact might give Röntgen rays of all orders up to the most penetrating. All celestial bodies might absorb such rays, and so tend to keep up their temperature. To account for the attainment of such high velocities by any particles it is supposed that near the sun the radiation pressure might exceed the gravitational force. That a particle once so started away would continue moving outwardly with an acceleration is inferred from the fact that both the radiation pressure and gravitation vary inversely as the distance squared. E. H. B.

2149. *Adaptation of the Stereo-comparator for Monocular Use.* **C. Pulfrich.** (Zeitschr. Instrumentenk. 24. pp. 161–166, June, 1904. Communication from the C. Zeiss Optical Workshops.)—The author describes an adaptation of the stereo-comparator, by which the advantages of the instrument [see Abstracts Nos. 708 and 1384 (1903)] can be made available to persons who are unable or only partly able to see stereoscopically. In this case the images from two plates are caused to pass through a double prism, the interface of which is covered with a semi-transparent silver film on which the images are superposed and viewed through an eyepiece. Each plate can be observed separately, when the image of a star, for instance, appears as usual; on viewing both plates, the *exactly* coinciding star images appear as before—dark stars on a white ground—whilst those objects which are only on one plate, as well as all the other non-coincident star images, are covered with a light shimmer. Another use described consists in substituting, for star comparisons, for one of the negatives, a diapositive taken from that negative. In this case all exactly coincident images which are on both plates disappear in the uniformly-lighted field, and only the non-coincident images remain—as dark points if on the negative, light if on the positive. The precautions for accuracy in use are detailed. L. H. W.

2150. *Effect of Chromatism of the Eye in Colour Vision.* **A. Polack.** (Comptes Rendus, 138. pp. 1538–1540, June 13, 1904.)—When an ordinary chromometric scale placed on a black ground is examined by the eye accommodated for a distance nearer than the object, red appears saturated, yellow becomes more orange, green more yellow, and blue acquires a violet tinge. If, however, the eye is accommodated for a distance greater than that of the object, blue becomes more saturated, green has a bluish tinge, yellow becomes greenish, and red faintly violet. The author's explanation is that when the eye is accommodated for one colour, the other colours produce on the retina, circles of diffusion in proportion to their refrangibility, and consequently the corresponding retinal image spreads over a larger surface and thereby loses intrinsic brilliancy. If the colour scale be on a white ground the above phenomena are reversed. This is because the white ground represents a luminous source of greater intensity than that of the colours, and produces in its turn circles of diffusion. H. W. P. Y.

2151. *Electrostatic Birefringence in Mixed Liquids.* **A. Zampetti.** (Accad. Lincei, Atti, 12. pp. 105–111, Aug. 2, 1903.)—From an examination of mixtures of carbon bisulphide with chloroform, carbon bisulphide with bromoform, benzene with chloroform, benzene with bromoform, and carbon bisulphide with benzene, the author deduces that the constant of Kerr for a mixture is connected with the constants K_1 and K_2 of its components by the linear relation $K = K_1 + (K_2 - K_1)V_2/100$ when V_2 is the volume of the liquid whose constant is K_2 in the mixture. The same form of condenser as that used by Schmidt was employed for obtaining the electric field, and the difference in phase between the ordinary and extraordinary rays was measured by a compressible glass compensator, standardised by comparison with a Babinet compensator. The birefringence does not immediately attain the value corresponding to a given electric field, but in successive stages after being subjected to the electric action for some time. W. H. Sl.

2152. *Refractive Power of Mixtures of Ethyl Ether in Chloroform.* **E. Tsytowitsch.** (Collection of physical papers devoted to the memory of T. T. Petrouchewsky, pp. 51–63, 1904.)—As a result of an experimental investigation of the connection between the refractive power of different mixtures of ether and chloroform, and the proportion in which these two bodies are mixed, the author arrives at the following conclusions: (1) The indices of refraction of ethyl ether and chloroform mixtures, calculated according to the formula for refractive indices in liquid mixtures, agree very closely with those found experimentally. (2) The greatest difference between the refractive indices of ether and chloroform mixtures and their mean value, was observed in mixtures made in the proportions of 50 or 60 per cent. by weight or approximately 35 per cent. by volume. (3) This maximum difference is observed in mixtures which have the highest dielectric constant. A. G.

2153. *Colour of the Ions.* **A. Pflüger.** (Ann. d. Physik, 12. 2. pp. 430–438, Aug., 1903. Physik Inst. der Universität, Bonn, May, 1903.)—The identity of the absorption spectra of dilute salt solutions containing a common coloured ion, has been demonstrated qualitatively by Ostwald, who has used this observation as evidence that the kathion and anion have an independent existence in dilute solutions. Quantitative experiments are now described with the following results: I. Permanganates in N/5000 solution. Percentage of light of wave-length 576 $\mu\mu$ absorbed by a layer of 30·5 mm. thickness :—

Barium permanganate,	26·4 per cent.	Zinc permanganate,	26·8 per cent.
Cadmium „	27·4 „	Ammonium „	26·5 „
Copper „	26·6 „	Aluminium „	27·1 „
Potassium „	25·6 „	Magnesium „	26·0 „
Lithium „	26·3 „	Nickel „	26·0 „
Cobalt „	25·9 „	Mean	26·3 „

II. In the case of the alkaline permanganates a fair agreement is also observed at a concentration of N/5, at which about 2/3 of the salt is ionised.

	Coefft. of ionisation.	Absorption by 0·1 mm. layer.
Sodium	About 60 per cent.	1·46 per cent.
Potassium..............	„ 75 „	1·40 „
Barium	„ 50 „	1·44 „

III. A good agreement was also observed in the absorption by very dilute solutions of *p*-rosaniline, using 1 cm. layers, and light of wave-length 546 $\mu\mu$.

	N/6000.	N/100000.		N/6000.	N/100000.
Sulphate	38·5	29·7	Salicylate	37·7	28·5
Nitrate	38·9	30·4	Hyposulphite	37·3	28·6
Acetate	37·6	29·2	Lactate	36·7	28·5
Benzoate	37·3	29·8			

T. M. L.

2154. *Reversible Photochemical Reactions in Homogeneous Systems.* I. *Anthracene and Dianthracene.* **R. Luther** and **F. Weigert.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 25. pp. 828–839, May 5, 1904.)—When a boiling solution of anthracene in phenetol, anisol, or xylene is exposed to the light of an arc lamp, it is partly converted into dianthracene; on the other hand, dianthracene is converted into anthracene when the solution in phenetol, anisol, or xylene is boiled in the dark. The reaction is important, as the only known instance of a reversible photochemical reaction in a homogeneous system, and has been studied by the authors with the result that it is found to be a monomolecular reaction. When a boiling solution of anthracene or dianthracene is exposed to light, the condition of equilibrium is established in a few hours. The concentration of the dianthracene in the equilibrial solution is (1) dependent on the kind of light used; (2) inversely proportional to the square of the distance from the lamp, and directly proportional to the relative intensity of the light; (3) proportional to the surface area exposed to the light; (4) independent of the thickness (from 1 mm. upwards) of the layer through which the light passes; (5) inversely proportional to the weight or volume of the solution; (6) nearly independent of the equilibrial anthracene concentration; (7) dependent on the solvent employed. Hence, with a given solvent, temperature, and light, a satisfactory empirical formula may be given to express generally the equilibrial concentration of the dianthracene.

D. H. J.

2155. *Index of Refraction of Aqueous Solutions.* **C. Chéneveau.** (Comptes Rendus, 138. pp. 1483–1486, June 13, 1904.)—The author has determined the refractive index (with a Féry refractometer) and the density (with a Mohr balance) of aqueous solutions of the following 35 substances, viz., the chlorides, sulphates, and nitrates of hydrogen, lithium, magnesium, ammonium, sodium, copper and potassium; potassium bromide; the nitrates of silver and lead; the nitrite, chlorate, and hydroxide of potassium; thallium sulphate; the chlorides of strontium, barium and mercury; sodium sulphite, thiosulphate, and hydroxide; ammonium hydroxide. The data given at first hand show no simple relation between the refractive index of the solution and the concentration (weight of substance per litre). If, however, we assume with Gladstone that the index of refraction is the sum of two terms—one depending on the solvent, the other on the dissolved substance—and then (admitting that the actual refraction of the water in the solution can be calculated by Gladstone's or Lorentz's law from the volume occupied), subtract the refraction due to the solvent (water) from the total refraction, we obtain a value Δ for the refractive index of the dissolved substance alone, and the author finds that the ratio (Δ/C) of this refractive index Δ to the concentration (C) is constant whatever the substance. In other words, the influence of the dissolved substance on the course of the luminous rays is an additive atomic property, and is independent of ionisation or hydration of the substance. D. H. J.

2156. *Quartz Lenses in Polarised Light.* **A. Herschoun.** (Collection of physical papers devoted to the memory of T. T. Petrouchewsky, pp. 11–25, 1904.)—Quartz lenses cut perpendicularly to the axis are often used for investigating ultra-violet light. In the case of polarised light and an analyser being used, the phenomena observed are sometimes complicated by the results of the rotation of the plane of polarisation, produced by the mass of the lens. The author shows analytically that the image observed through the analyser is formed by the superposition of non-polarised light and a beam of light of rectilinear polarisation, the plane of polarisation of which is turned by an angle $\frac{a\mathrm{D}}{2}$, while the intensity is proportional to $\frac{\sin a\mathrm{D}}{a\mathrm{D}}$, where a denotes the rotation produced by unit length of the quartz, and D the thickness of the lens. The intensity varies during the rotation of the analyser, this variation diminishing, however, periodically, as the thickness of the lens increases from 0 to 8 mm., which is the maximum thickness of usual lenses. With incident white light, a colouration that manifests itself in absorption bands in the spectroscope is generally obtained. By employing a bi-convex lens formed of two equivalent plane-convex lenses, one left-handed and the other right-handed, the rotation of the plane of polarisation is compensated for, but only for rays issuing from a point at the double focal distance from the lens, or else for the parallel beam between the identical objectives of a collimator and a spectrometer telescope. A. G.

2157. *Action of Inorganic Compounds on the Rotation of Quinic Acid.* **E. Rimbach** and **P. Schneider.** (Zeitschr. Phys. Chem. 44. pp. 467–486, July 17, 1903. Chem. Institut d. Univ., Bonn.)—The power of changing, to any appreciable extent, the rotatory power of quinic acid is confined to members of the carbon group—titanium, zirconium, tin, and thorium—and those of the oxygen group—molybdenum, tungsten, and uranium—all of which elements form oxygen compounds of a more or less marked acid character. With other oxy-acids, compounds of molybdenum, tungsten, and uranium are especially active in increasing their rotatory power; they also exert the same influence with quinic acid, and the same is the case with zirconium compounds. With malic, tartaric, and quinic acids, the increase in rotation produced by compounds of the above four elements diminishes as the number of hydroxyl groups in the molecule of the acid increases. It is found that the change of rotation is greatest when the inorganic compound and the quinic acid are present in certain molecular proportions. The cause of these phenomena lies, doubtless, in the formation of complex compounds, having a higher rotatory power than the quinic acid itself. Most inorganic compounds, however, have only a very slight influence on the rotation of quinic acid, which is also nearly independent of the dilution.

T. H. P.

2158. *New Case of Optical Isomerism.* **O. Wallach.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 1. pp. 9–17, April 30, 1904.)—On benzoylating the lævo-rotatory oxime ($[\alpha]_D = -43^\circ$) of the dextro-methylhexanone ($[\alpha]_D = +13^\circ$), it is found that two optically different benzoyl-compounds are obtained: (1) The α-compound, melting at 96–97°, having the $[\alpha]_D + 19{\cdot}97^\circ$ and crystallising in hemimorphic monoclinic forms; (2) the β-compound, melting at 82–83°, having the $[\alpha]_D - 86{\cdot}08^\circ$ and forming rhombic crystals. These compounds are supposed by the author to be anti- and syn-modifications, which are possible according to Werner and Hantzsch's theory, if the valency-directions do not lie in a plane. This view is confirmed by the fact that two benzoyl-derivatives can be derived from the inactive modification of the oxime. It is seen from the properties of the α- and β-compounds given above, that this isomerism, conditioned by the valency-directions of the nitrogen, may give rise to differences in optical behaviour as great as those shown by structural or position isomerides. It should be remarked that such nitrogenous compounds, even when they contain only one asymmetric carbon atom, may exist in more than three optically different isomerides.

T. H. P.

2159. *Rotation Values of Methyl, Ethyl, aud* n*-Propyl Tartrates at Different Temperatures.* **T. S. Patterson.** (Chem. Soc., Journ. 85. and 86. pp. 765–776, June, 1904.)—The data obtained by the author for the variation of rotation with change of temperature of methyl, ethyl, and *n*-propyl tartrates, show that comparisons of these data at identical temperatures, especially low ones, are of little value. Since the rotations of methyl, ethyl, and *n*-propyl tartrates vanish at 0°, —34°, and —60° respectively, it may be assumed that these substances are in corresponding optical conditions at these temperatures, and in general that at T°, (T — 34)°, and (T — 60)°, the methyl, ethyl, and *n*-propyl esters will also be in corresponding conditions as regards rotation. It is found that comparisons effected at corresponding temperatures are much more satisfactory than those obtained at identical temperatures. If the rotations are taken at corresponding temperatures, the increment of $2CH_2$ in passing from methyl to ethyl tartrate rather more than doubles the rotation, whilst the next increment of $2CH_2$ in passing to *n*-propyl tartrate increases the rotation 1·41 times. These regularities persist within wide limits of temperature.

T. H. P.

2160. *Fixity of Lines in Solar Spectrum.* **M. Hamy.** (Comptes Rendus, 138. pp. 1156–1157, May 9, 1904.)—Attention has recently been drawn to the variation of the character of the line λ508 of cadmium according to the mode of excitation of the metallic vapour giving the spectrum, and its great importance in consequence of this line having been chosen as the standard for the new interferential measures of standard wave-lengths. The author suggests that an attempt be made to determine any variation in the solar spectrum lines during the many different conditions obtaining throughout the great changes in solar activity. [See also Abstract No. 1347 (1904).]

C. P. B.

2161. *Ultra-red Absorption Spectrum of Organic Liquids.* **M. Iklé.** (Phys. Zeitschr. 5. pp. 271–277, May 15, 1904. Extract from Berlin Inaugural Dissertation.)—The substances used were: Methylene chloride, chloroform, carbon tetrachloride, methyl iodide, methylene iodide, ethyl alcohol, ethyl bromide, ethyl iodide, ethyl ether, ethylene chloride, ethylidene chloride, isobutyl alcohol, bromoform, carbon bisulphide. As source of heat one of the Zirkon burners of Max Wolz (of Bonn) was used; as material for the prism fluorite was chosen. The film of absorbing liquid was placed between two plane-parallel plates of fluorspar. From the data given the author concludes as follows: (1) If the hydrogen or hydroxyl of an organic liquid is replaced by a halogen the diathermancy is increased. This increase is distributed over the whole ultra-red spectrum, and is generally greatest for the waves of least diathermancy. No displacement of the minima, such as Krüss and Oeconomides observed for the visible spectrum in consequence of the substitution of halogen, could be recognised in the present experiments. (2) No generalities as to the ultra-red absorption spectra of isomeric liquids can be deduced from the data. (3) All the substances studied show a diathermancy minimum at about 3435 μμ. The author ascribes this minimum to the presence of the carbon atom. Most of the compounds also show a minimum 5–5·2μ.

D. H. J.

2162. *Reversals in the Spectra of Sun-spots.* **W. M. Mitchell.** (Astrophys. Journ. 19. pp. 357–359, June, 1904.)—Working with the grating spectroscope attached to the 23-in. refractor at Princeton, U.S.A., using the third order spectrum, the author was able to observe many reversals in the lines given by the spots visible during March and April of 1904. In the region between λλ4915 and 6770 over 270 lines were found to be more or less affected, and a table is given of 69 of these which were decidedly reversed. The chief lines of magnesium, iron, and sodium have not been observed to be affected in any way, and the helium line D_3 was not visible in any observation.

C. P. B.

2163. *Origin of the Blondlot Rays Emitted during Chemical Reactions.* **A. Colson.** (Comptes Rendus, 138. pp. 1098–1099, May 2, 1904.)—The author finds that when a supersaturated solution of sodium sulphate is made to crystallise it gives out n_1-rays. A mixture of solutions of aluminium sulphate and potassium sulphate does not give out n_1-rays till crystallisation (with formation of alum) is started. Chrome alum thrown into *cold* water causes an increase in the brilliancy of calcium sulphide; thrown into *hot* water it causes such an active disengagement of n_1-rays that the phosphorescence of the sulphide caused by the hot water alone may completely disappear. The emission of n_1-rays in these cases may be due to the accompanying physical changes, and in support of this the author finds that a rapid cooling of water or of a chrome-alum solution gives rise to n_1-rays, whereas the heating of water causes the emission of n-rays. [See also Abstracts Nos. 1365, 1655, and 1658 (1904).] D. H. J.

2164. *On the Emanation Substance (Emanium).* **F. Giesel.** (Chem. News, 89. pp. 267–268, June 3, 1904. From Ber. Deut. Chem. Gesell. 37. p. 1696, 1904.)—The investigation, by Runge and Precht, of the spark spectrum of the emanation substance showed that it consisted essentially of lanthanum with a little cerium, and that thorium, barium, and radium were not present. Glass vessels in which the substance has been kept for some months become violet-coloured up to the level to which they were filled. Paper becomes brown and is destroyed. The activity of the solid salts suffers no further change as soon as the maximum has been reached about a month after they have separated out from the solution. This observation, characteristic of the primarily active elements, removed the last doubt as to the presence in the material of a new radio-active element different from radium and belonging to the class of the rare earths. Again, it is not possible to impart to inactive rare earths the properties of emanium by merely bringing them into contact with radium salts. [See also Abstract No. 753 (1904).] T. M. L.

2165. *Emanation of Radium.* **W. Ramsay.** (Comptes Rendus, 138. pp. 1388–1394, June 6, 1904.)—A full account is given of the experiments of the author and his collaborators on the emanation of radium. The emanation behaves like an ordinary gas and resembles the gases of the argon family, being without chemical activity, and having a spectrum similar to the inert gases of the air. It is visible on account of its luminosity, and follows Boyle's law. The author proposes to give it the name *Exradio*. A table of the wave-lengths of the lines of the spectrum of the emanation is given. The emanation is probably monatomic with a density about 80 and an atomic weight about 160. From the rate of transformation the mean life of the atom of radium is calculated to be 1,050 or 1,150 years. Attempts have been made, but without success, to cause the electrons which escape from Exradio to penetrate into other bodies. J. J. S.

2166. *Radio-activity of Earths and Sediments.* **J. Elster** and **H. Geitel.** (Phys. Zeitschr. 5. pp. 321–325, June 15, 1904.)—A description is given of an improved electroscope for measuring the radio-activity of earths and similar substances. The investigation of volcanic earths gave results somewhat similar to those previously recorded, and a further investigation of the sediments from thermal springs is recorded. In certain instances these sediments proved to be highly active, the activity of the deposit in the pipes at Wiesenbad being comparable with that of uranium salts, and giving remarkable phophorescent effects with zinc blende under certain conditions. As the distance from the source increases the water becomes less and less active. The deposit in the cooling tanks has much less activity than that in the pipes, and the chalk which finally separates when the water is exposed to the air is quite inactive. T. M. L.

2167. *Influence of Alterations of Temperature on Radio-active Substances.* **S. Meyer** and **E. v. Schweidler.** (Phys. Zeitschr. 5. pp. 319–320, June 15, 1904.)—The substances investigated were metallic uranium, uranium nitrate (crystals and solution), pitchblende, polonium (precipitated on a rod of bismuth) and radium-barium carbonate. In each case it was found that a moderate rise of temperature (always below 200° C.) caused a marked decrease in the rate of discharge of an electroscope by the radio-active material. This decrease persisted somewhat longer than the rise of temperature, and might be attributed either to a decrease in the activity of the material or to changes in the air through which the discharge took place. As regards the latter, it is to be noticed that a high temperature would tend to increase the ionic mobility, whilst actually a decrease of conductivity was observed. A further experiment showed that at the higher temperature the voltage used was still sufficient to produce the saturation-current between the electrodes, and the decrease cannot therefore be accounted for in this way. Another possibility was that at the higher temperature the air, owing to its lower density, did not absorb so large a proportion of the energy radiated from the active material, but this view is disproved by the fact that the decrease of conductivity persists after the air has reached its normal temperature, and, moreover, direct experiments in which the pressure of the air was altered by means of a pump showed no effects of this kind. The only conclusion remaining is that the activity of the material decreases as the temperature rises. Such a decrease might in the case of radium or thorium be attributed to the liberation and loss of the emanation, but this explanation is not applicable to uranium and polonium, and even in the other cases an initial *increase* of activity would be expected. The conclusion arrived at is that there is actually a decrease of radio-activity as the temperature rises, a conclusion that is in agreement with the observations of Dewar and Curie on the heat liberated from radium salts at the temperature of liquid hydrogen. In qualitative agreement with certain observations of Madame Curie is the fact that the decrease is most marked in the case of the α-radiations, whilst the smallest effect was observed in the case of polonium which gives only α-rays.

T. M. L.

2168. *Radio-activity and Matter.* **C. Winkler.** (Chem. News, 89. pp. 289–291, June 17, 1904.)—The researches on the radio-activity of substances cannot be regarded, generally speaking, as adequate from a chemical point of view. Even the results of fractionation are to be accepted with circumspection because they may easily give rise to fallacies. In the early days of spectral analysis it was believed that calcium had been decomposed, because it was possible to cause the disappearance of the green line of its spectrum in one of the parts obtained by fractional precipitation of a solution of calcium chloride. It is therefore urged that in the majority of cases radio-activity should be regarded, until further chemical evidence is adduced, as a purely physical process, a phenomenon that may adhere to matter without influencing its chemical composition, in much the same way as the magnetism of iron oxide. In this connection it is noteworthy that radium is never associated with its homologue barium in any of the commoner ores, but invariably with uranium, an element which may conceivably be (with thorium ?) the primary source of all radio-activity.

T. M. L.

2169. *Emanations and Radiations.* **Berthelot.** (Comptes Rendus, 138. pp. 1553–1555, June 20, 1904.)—The author suggests that many of the observed phenomena may be due to surface films of volatile substances condensed from the atmosphere. The smell of metals may be due to the same cause. Impalpable dust may also be another cause, the dust being made to impinge on the metal surface by electric forces. Emanations are not necessarily simple; those from phosphorus contain phosphorus, oxides of phosphorus, ozone, and H_2O and HNO_3 vapours. Surface films play a very important part, for example, in the e.m.f. between metals on contact. A. D.

2170. *The Succession of Changes in Radio-active Bodies.* **E. Rutherford.** (Roy. Soc., Proc. 73. pp. 493–496, June 22, 1904. Abstract of Bakerian Lecture.)—A summary is given of the results obtained in recent experiments on radio-activity. The complicated curves showing the decay of activity, which have been obtained for the different types of rays, and for different times of exposure, can be completely explained on the supposition that there are three rapid, successive changes in the matter deposited by the radium emanation—(1) A rapid change giving rise only to α-rays, in which half the matter is transformed in about 3 min.; (2) A "rayless" change in which half the matter is transformed in 21 min.; (3) A change giving rise to α, β, and γ rays together, in which half the matter is transformed in 28 min. J. J. S.

2171. *Rate of Decay of Thorium Emanation.* **C. Le Rossignol** and **C. T. Gimingham.** (Phil. Mag. 8. pp. 107–110, July, 1904.)—The authors, during the course of experiments with a substance suspected to be thorium, had occasion to measure the time taken for known thorium emanation to decay to half value; and the value obtained was considerably lower than that found by Rutherford [see Abstract No. 631 (1900)]. A series of new determinations was therefore made, apparatus almost identical with that of Rutherford being used; and the method employed consisted in blowing a definite quantity of the emanation through a calcium chloride drying tube, noting the time, then closing the tube and breaking the earth of the insulated quadrant of the electrometer, when readings were taken every 5 sec. over a period of 400 sec. Any residual emanation was immediately blown out, and the rate of charge due to excited activity taken as quickly as possible. From the deflections obtained, given in a table, the curve due to the emanation alone is deduced by subtraction. The logs. of the ordinates measured from an asymptote to this curve, give a straight line when plotted, hence the curve is a true exponential. The time for decay to half value was found to be 51·2, 50·8, and 51·5 sec. in three different experiments (mean 51·2), as compared with Rutherford's value, 60 sec. L. H. W.

2172. *New Observations with a Phosphorescent Screen.* **E. Bichat.** (Comptes Rendus, 138. pp. 1254–1257, May 24, 1904.)—Observation of the effects produced by ozone and liquid air on a phosphorescent screen induced the author to examine whether other gases produced similar effects. Gases in sealed tubes held in the hand all produced more or less effect, increasing the brightness of the screen, and those gases formed without condensation were seemingly much more feeble in their action than gases formed with condensation. On placing the tube on a wooden support instead of in the hand, oscillations of brightness were noticed, a quite different behaviour. A special arrangement for more conveniently observing this variation in the brightness of the sulphide is then described. The phenomenon can be produced by other means, such as passing a current of air through a narrow tube, open at both ends; or by moving the air behind the window about by the hand; or by placing a horizontal sheet of metal behind the window and then gently heating it. On the metal cooling, the period of oscillation increases as time goes on, and the effect on the screen ceases as soon as the metal acquires the room temperature. Certain bodies, such as wood painted with white lead, and copper, are opaque to these radiations, others, such as zinc, are transparent. The action is not due to a difference of temperature between the ends of the tube, as a special experiment with a copper envelope to the tube showed. Such oscillatory effects on the screen are also produced by most solid, liquid, and gaseous bodies, with rare exceptions, among which are amianthus, not at all; caustic potash and baryta, almost no effect; and dry sodium chloride, hardly any effect. Water alone produces no effect, but a morsel of sodium chloride dropped in produces oscillations, rapid at first and dying slowly away, to disappear when dissolution is complete. Other examples, showing that the screen is extremely sensitive to the changes in a body due to physical, chemical, or physiological causes, are given, and anæsthetisation experiments similar to those of J. Becquerel [see Abstracts Nos. 1657 and 1966 (1904)] are described. [See also Abstracts Nos. 1358 and 1658 (1904).] L. H. W.

2173. *Phenomenon analogous to Phosphorescence produced by* N-*rays.* **E. Bichat.** (Comptes Rendus, 138. pp. 1316–1318, May 30, 1904.)—The author describes some experiments on the secondary radiations emitted by bodies which store up the *n*-rays. A leaf of thin copper exposed to the *n*-rays of a Nernst lamp for 1 min., afterwards emitted *n*-rays from the exposed side, but not from the other side. On gently heating the copper whilst the screen is being observed, the sulphide brightens, but only for an instant; the brightness diminishes and the *n*-rays disappear, the effect being analogous to that observed on heating ordinary phosphorescent substances. An *n*-ray spectrum was obtained by means of an aluminium prism, and the position of the different refracted rays determined by moving a phosphorescent screen along the spectrum. Eight successive maxima were observed corresponding to the indices determined by Blondlot [see Abstract No. 764 (1904)]. After this the body, the secondary radiation of which is to be observed, is placed so that it is exposed to one of the rays from the prism; for instance, the ray No. 3 (of index 1·29) for a certain time. The source of *n*-rays is then removed and the exposed body is put in its place. The dispersion is then examined by means of the phosphorescent screen, and it is found that the bundle of secondary radiations is complex; there are a certain number of maxima, but these all correspond to indices *higher* than that of the primary radiation. This result is general, no ray of lower index than the primary is to be found, so the primary radiations must be transformed into more refrangible ones, since Blondlot has shown that the wave-length increases with the refractive index. This is also in accordance with Stokes' law. The preceding results were verified by direct measurements of the wave-lengths; and in this way the secondary radiations of copper, zinc, and glass were studied, but platinum, silver, and aluminium showed no secondary radiation. There is thus no relation between this property of secondary emission and the transparency of the body to the *n*-rays. L. H. W.

2174. *Action of* N-*rays.* **R. Blondlot.** (Comptes Rendus, 138. pp. 1394–1395, June 6, 1904.)—The author supports the explanation given by J. Becquerel of the change that the *n*-rays produce in the visibility of a phosphorescent screen as being due to the absorption of the incident *n*-rays by the screen and the giving out of other *n*-rays which accompany the luminous rays and increase the sensitiveness of the retina [see Abstract No. 1652 (1904)]. When, however, the *n*-rays fall on a small electric spark the intensity of the emitted light is actually increased. This is shown by the photographic effects, and by the fact that the change in brightness is visible when the small source of light is viewed through a trough of distilled water. The same remark applies to the changes in visibility of a sheet of platinum raised to dull redness. J. J. S.

2175. *Perpendicular Emission of* N- *and* N_1-*rays.* **E. Bichat.** (Comptes Rendus, 138. pp. 1395–1396, June 6, 1904. If during the oscillations of brightness of a phosphorescent screen [see Abstract No. 2172 (1904)] an oxidised plate of lead be interposed between source and screen at the moment of minimum brightness, the brightness is seen to augment, the screen receiving n_1-rays; if interposed at the moment of maximum brightness no change is produced. The sources examined behave as though they themselves emitted n_1-rays in an intermittent fashion. On grounding the source of the radiations the oscillations of luminosity cease, and the screen shows that a constant emission of *n*-rays is going on in the first case, of n_1-rays in the second case. A source of *n*-rays is obtained by grounding a sheet of metal by means of a copper wire. That the rays come from the earth is shown by oxidising the copper wire by heating it, in which case the copper ceases to conduct the *n*-rays, as previously shown by the author [see Abstract No. 1071 (1904)]. If a concave metal mirror be used as source of *n*- or n_1-rays, and the screen be moved in front of it, the rays are seen to converge upon the centre of curvature of the mirror; the rays are therefore normal to the surface of emission. The cone formed by the rays, however, has an angle slightly smaller than the geometric cone having the centre of curvature as apex and the mirror as base, as has been observed in the case of kathode rays. L. H. W.

2176. *Apparent Variations in the Luminosity of a Phosphorescent Screen when Examined in a Dark Room.* **F. P. Le Roux.** (Comptes Rendus, 138. pp. 1413–1415, June 6, 1904.)—For the experiments a black screen was used, in the centre of which an area 2 cm. or 3 cm. in diam. was coated with a luminous paint. When the observer, covering one eye, gazes fixedly at the luminous spot, a diminution of its brilliancy is usually noticed at the end of half a minute, which continues until it reaches a more or less stationary condition. Often a sensation is experienced as if a cloud were passing over the screen. To some observers the light appears to diminish in brightness with oscillations, and the diam. of the luminous area often appears to grow less. The observer may regain the initial sensation of brightness by gentle pressure on the eye or by coughing or shouting. These phenomena are in part at least of a psychical nature. The inhalation of small quantities of ether or chloroform vapour has a marked effect in lessening the apparent brilliancy of the screen. These facts are of interest, as they suggest a possible source of error in the investigation of the phenomena of *n*-rays. H. W. P. Y.

2177. *New Method for Observing* N-*rays.* **R. Blondlot.** (Comptes Rendus, 139. pp. 114–115, July 11, 1904.)—The author describes a new method which enables the *n*-rays to be studied with ease and without fatigue. This consists in observing the appearance or disappearance of a luminous beam on a background dimly illuminated by the complementary colour, instead of determining the variation in brightness of a phosphorescent beam on a black ground as heretofore customary. For this purpose a piece of grained white cardboard has a phosphorescent patch of sulphide 1–2 mm.

wide and 2–3 cm. long on it, and after insolation is put in a dark place, and the light from a lamp provided with an orange-yellow glass front, placed 2 to 3 m. away, caused to fall upon the cardboard. The lamp flame is then regulated until the blue glow from the sulphide is invisible on the yellow ground. If things are so arranged that normally the phosphorescent spot just disappears, on *n*-rays affecting the screen the blue beam appears, to disappear again as soon as the *n*-rays cease. Similarly, by arranging matters so that the spot is normally just visible, the presence of n_1-rays will be indicated by the spot disappearing. The same precautions are necessary as in observing the *n*-ray effects by the usual method—all effort and straining of the sight must be avoided if the physiological and psychic effects described by Lummer [see Abstract No. 553 (1904)] and by Le Roux [see Abstract preceding] are to be absent. L. H. W.

2178. *Action of Radium on Diamond.* **W. Crookes.** (Roy. Soc., Proc. 74. pp. 47–49, July 19, 1904.)—It has been shown that when radiant matter impinges on diamonds they assume a dark colour and become almost black after a long bombardment. Some diamonds blacken in the course of a few minutes, whilst others require an hour or more to discolour. Although only superficial, this blackening requires a polishing with diamond powder to remove it. Diamonds which had been blackened by the author were submitted to Moissan. When heated to 60° in an oxidising mixture of $KClO_3$ and fuming HNO_3 (prepared from mono-hydrated H_2SO_4 and KNO_3 fused and dry) the action on the black layer is very slow. There is produced graphitic oxide which at an increased temperature yields pyrographitic acid easily destroyed by HNO_3. Hence the diamond has by the radiant matter become coated with graphite. It is known that the higher the temperature to which graphite is submitted the greater is its resistance to oxidation, Moissan concludes that the temperature reached by the surface of the diamond in Crookes' tubes is probably about 3,600°. The β-rays from radium having properties like the kathode stream, it was of interest to ascertain if they exert an action on diamond. A Bingara diamond was kept close to a quartz tube containing about 15 mgm. of radium bromide sealed *in vacuo*. It phosphoresced brightly and continued to glow the whole time of experiment. No, or very little, darkening was produced in six weeks. The diamond was now put inside the tube so that it was immersed in the salt. After 78 days a decided effect was produced, the diamond becoming of darker appearance and of a bluish-green tint. It was now heated to 50° C. in a mixture of strongest HNO_3 and $KClO_3$ for ten days, the mixture being renewed each day. At the end of this time the diamond had lost its dull surface colour, but its tint had changed from a yellow to a pale blue-green. Hence the β-rays or electrons effect a superficial darkening due to graphite and also one penetrating through the whole thickness of the diamond. It is possible that the constant state of vibration in which the diamond is kept, as revealed by its phosphorescence, may have caused an internal change that may be chemical or physical or both. If the original yellow colour is due to iron in the ferric state, a reduction to the ferrous state would account for the change of colour to a pale blue-green. This alteration of colour may be of commercial importance. If "off colour" stones can be lightened their value will increase, while if the prolonged action of radium gives them a decided colour they would be of greater value as "fancy" stones. After 10 days' heating it was found that 35 days afterwards the diamond was able to effect a photographic film, thus further showing that the stone had been given a strongly radio-active property in its deep layers. W. W. H. G.

2179. *Nature of the* N- *and* N_1-*rays, and Radio-activity of the Bodies Emitting these Rays.* **J. Becquerel.** (Comptes Rendus, 139. pp. 264–267, July 25, 1904.)—The author points out that the rays from a Nernst lamp, as he is informed by Blondlot, do not lose their property of affecting a sulphide screen even after passing through a magnetic field of 10,000 units, although a much weaker field inhibits the effect from other sources. [See Abstract No. 1660 (1904).] Experiments are described, using a fixed and a movable glass tube in the field of a Weiss electromagnet, which show that in a bundle of Blondlot rays exposed to the action of a magnetic field there can be recognised (1) a *non-deviated portion* which, for the bodies examined, with the exception of the Nernst lamp as source, has no action on the screen; (2) a deviated and considerably dispersed portion composed of rays identical with kathode or β-rays; (3) a portion deviated in the same sense as the α-rays, which, like these, diffuse rapidly, but are more easily deviable; they are present in all the sources of the rays and diminish the brightness of the screen. Apparent selective absorption was also observed when a zinc sulphide screen was substituted for the calcium sulphide one. The maxima observed on the calcium screen, in a field of 237 units, gave values of the product R H (R = rotation of movable tube) as follows:—

1	2	3	4	5	6	7	8
10,590	8,100	6,090	4,900	3,840	2,891	2,360	2,040
9	10	11	12	13	14	15	16
180	1,630	1,480	1,350	1,250	1,140	1,000	700

and it is pointed out that for the least deviated β-rays of radium, the value of RH (10^4 about) is very close to that obtained above (10,590), and shows the identity of these rays with the β-rays. All the sources tried gave these least-deviated rays, but the spectrum only extends as far as 5 in the case of Prince Rupert's drops, 11 in the case of steel, 15 in the case of radium (in glass tube), 16 with the calcium sulphide screen, and much further even in the case of rays emitted by the median nerve of the wrist. The deviation of the α-type rays is estimated from an experiment, and a method of showing the existence of the non-deviated rays described. It is concluded, as a result, that sources of *n*- and n_1-rays emit three sorts of radiations, like radio-active bodies, but whereas the non-deviable γ-rays of radio-active bodies cannot be refracted, the non-deviable part of the Blondlot radiation can be refracted by an aluminium prism [see next Abstract] along with the α- and β-rays, the latter probably by a succession of secondary effects. According to the predominance of the action of the α- or the β-rays on the screen, the effects of the *n*- or n_1-rays are observed. L. H. W.

2180. *Refraction of the* N- *and* N_1-*rays.* **J. Becquerel.** (Comptes Rendus, 139. pp. 267–270, July 25, 1904.)—The author has shown that the non-deviated portion of a beam of *n*- and n_1-ray radiations is in general (with the exception of *n*-rays from a Nernst lamp, to which this investigation does not apply) without action on the calcium screen [see preceding Abstract], and he now shows that it can be transformed anew into *n*-rays by passing it over a substance emitting β-rays, into n_1-rays by a source of α-rays. The arrangement adopted consisted of a source (calcium sulphide, sunned and under the action of a radio-active substance emitting β-rays), placed on the base of an aluminium cone which concentrated the greater part of the radiation at the apex. The rays were passed through a glass tube which traversed a magnetic field normally to the lines of force and fell with normal incidence on an aluminium prism of 30°. (1) With the magnet unexcited, a certain number of beams of n-rays and three beams of n_1-rays very little deviated and separated by n-rays were observed at the side, near the base of the prism. At the side near the apex, wide bands of n_1-rays, very weak and visible with difficulty, were seen (concerning which more will be published later). (2) When the incident beam traverses the magnetic field all the n- and n_1-rays disappear, but a salt of uranium placed in the path of the non-deviated beam will cause the beams of n- and n_1-rays, as well as the bands, to reappear in the same positions as before. (3) With a polonium-bearing bismuth salt (source of α-rays) all the n groups are replaced by n_1 groups, and the three n_1 bands towards the base, as well as the n_1 bands beside the apex, are transformed into bands of n-rays. (4) Superposition of the n- and n_1-rays can be obtained, forming an inactive beam on the screen, by the use of both uranium and polonium salts; the incident beam being neutral, no refracted ray can be observed; the aluminium prism has not separated the n- and the n_1-rays. This apparently contradictory result as compared with the existence of separated n- and n_1-rays in the spectrum of a source of Blondlot rays is commented on and possible explanations given, and experiments are described in the course of which, rays were observed which do not propagate themselves at a distance greater than 2 cm. from the n-ray beam, and which are very slightly penetrating only, a single sheet of paper protecting the sulphide from their action. L. H. W.

REFERENCES.

2181. *Emission from Bodies of Finite Absorption.* **J. Koenigsberger.** (Ann. d. Physik, 12. 2. pp. 342–355, Aug., 1903.)—A mathematical investigation (1) of the validity of Kirchoff's law of the connection between emission and absorption, (2) of the Stefan-Boltzmann law of the dependence of radiation upon temperature, (3) of the law of absorption. J. W. P.

2182. *Transparency of Jena Optical Glass for Ultra-violet Rays.* **H. A. Krüss.** (Zeitschr. Instrumentenk. 23. pp. 197–207, July, and pp. 229–239, Aug., 1903.)—A determination of the absorption of ultra-violet rays in ten kinds of crown and flint glass through the range λ480 to λ309. Curves and tables are given showing the variation of transparency with thickness and wave-length. There is no outstanding difference between the crown and flint glasses, all showing the characteristic absorption increasing slowly in the visible spectrum and very quickly towards the limits of transparency. The method is a differential one, two polarised beams from the same source passing through different lengths of the glass under test, and eventually falling on a fluorescent screen. The theory of the method is explained. G. E. A.

2183. *Light Filters for Three-colour Printing.* **A. Miethe.** (Photographic Journ. 43. pp. 214–218, Aug., 1903. Paper read before the Jubilee Commemoration Congress.)—A method has been found by means of which the same set of red, green, and blue filters is used along with plates of any colour-sensibility whatever. The blue print is exposed through red and green filters for times in the ratio of 15 to 1, the red print through green and blue filters for an exposure ratio of about 30 to 1, and lastly the yellow print through the blue filter only. The above is for panchromatic plates dyed in ethyl-red. The method possesses technical difficulties, and is, unfortunately, hardly applicable in photographing from nature, but the possibility of obtaining good results without carefully adapted filters is a great advantage. G. E. A.

2184. *Anomalous Dispersion, Absorption, and Surface Colour of Nitroso-dimethylaniline.* **R. W. Wood.** (Amer. Acad., Proc. 39. 4. pp. 51–66, Aug., 1903.)—This substance exhibits a very exceptional dispersion, so that a candle viewed through a prism of it is spread out into a spectrum fifteen or twenty times as long as that given by a glass prism of the same angle. The present paper contains a detailed account of the dispersion in the ultra-violet and in the visible spectrum, as well as of the changes in the position of the absorption band, which accompany a change of state (from solid to liquid or liquid to gas). The results cannot be fully discussed till measurements have been made in the infra-red and the dielectric constant of the body has been determined, but so far they are in accord with the electromagnetic theory of dispersion and absorption. The dispersion of toluene is dealt with incidentally in the paper. D. H. J.

2185. *Stereoscopic Range-power of Prismatic Binoculars.* **F. J. Cheshire.** (British Optical Journ. 3. pp. 16–19, Sept., 1903.)—The stereoscopic range for normal binocular vision is E/a, where E is the inter-pupil distance and a the minimum angle of convergence which can produce stereoscopic relief. The method of measuring the range is described, Helmholtz's value being 235 m. In telescopic vision the stereoscopic range is equal to the product of the range in unaided vision and the magnifying power of the binocular telescope, inter-ocular and inter-objective distances being equal. If the latter are unequal, as in the prismatic binocular, the above product has further to be multiplied by the ratio of these two distances. G. E. A.

2186. *Connection between Light-Radiation and Temperature.* **F. Jablonski.** (Elektrotechn. Zeitschr. 25. pp. 374–375, May 5, 1904.)—The author points out that Eisler's results [see Abstract No. 1322 (1904)] agree with those obtained by Rasch, inasmuch as they both point to the fact that xt is constant, and equal to about 25,000 t being the absolute temperature, and x given by the equation $h = t^x$, where h is the total radiation. From this it would appear that x tends to the value zero, whereas Lummer and others contend that it asymptotically reaches the value 12. W. H. S.

2187. *Cylindrical Lens Systems.* **G. J. Burch.** (Roy. Soc., Proc. 73. pp. 281–286, May 7, 1904.)—An arrangement of two lenses with axes crossed may be used for comparing by photography, curves plotted to different scales or for increasing or diminishing the ordinates of a curve. Examples from capillary-electrometer records are given. Cases with axes parallel are also described. J. W. P.

2188. *Lamellar Double Refraction.* **O. Wiener.** (Phys. Zeitschr. 5. pp. 332–338, June 15, 1904. Physik. Instit. der Universität, Leipsig, May 26, 1904.)—A mathematical paper somewhat difficult to abstract. R. S. W.

2189. *New Process of Three-colour Photography.* **R. W. Wood.** (Comptes Rendus, 138. pp. 1694–1695, June 27, 1904.)—Three positives, prepared by means of coloured glass, are printed successively on the same bichromatised gelatine plate, using three diffraction gratings for the purpose, specially traced so that the red, green, and blue rays are deviated in the same direction. This triple proof is developed with warm water and dried, and must be seen by parallel light, being invisible in diffused light. W. H. Si.

2190. *Wedge-Compensation Saccharimeters.* **O. Schönrock.** (Ann. d. Physik, 14. 2. pp. 406–417, June, 1904. Communication from the Physikalisch-Technische Reichsanstalt.)—The following points are dealt with: Rotation of the quartz plate for different kinds of light, rotation for temperature, rotation for mixed light and for different observers, effects of mixed light as contrasted with homogeneous light. J. W. P.

2191. *Refractive Indices of Some Oils.* **N. Georgiewski.** (Collection of physical papers devoted to the memory of T. T. Petrouchewsky, pp. 41–51, 1904.)—The author as far back as in 1888 and 1889, on a suggestion by Petrouchewsky, determined the indices of refraction (for the bands of hydrogen and D lines) of some oils, and more especially of such oils as are used in painting. He now investigates the influence of the viscosity of these oils and of temperature, the following conclusions being drawn: (1) The refractive indices of sunflower, hemp, nut, linseed, cucumber, and poppy oils are intermediate between the limits 1·4763 (for cucumber oil) and 1·4842 (for linseed oil). (2) The refractive indices of oils increases with the viscosity. (3) The dispersion of the oils investigated is practically identical. (4) The variation with the temperature in the refractive indices of the various oils is controlled approximately by the law of Gladstone and Dale, between the limits 20° and 42°. A. G.

2192. *Identification of Alkaloids by Refractive Index Measurements.* **P. Kley.** (Zeitschr. Anal. Chem. 43. pp. 160–167, 1904.)—It is proposed to identify alkaloids by mounting a small fragment of a broken crystal in a medium of known refractive index. Using crossed nicols the stage is rotated until the crystal causes extinction, when the upper nicol is removed and the fragment examined in that position and in a position at right angles to it. The various known media are then tried, until accurate determinations of the refractive indices in the two positions have been made. The difference between the two values gives the value of the double refraction. The crystal is positive if the index of its extraordinary ray be the greater and negative in the reverse case. A table is given of the values obtained with different alkaloids and of the refractive indices of suitable liquids. L. H. W.

2193. *Magnetic Deflection of Röntgen Rays.* **B. Walter.** (Ann. d. Physik, 14. 1. pp. 99–105, May, 1904. Hamburg State Laboratory, Jan., 1904.)—Strutt's results extended; there is no deflection greater than would correspond to a radius of curvature of 10^{11} cm. for a field of 1 gauss. The field used had a strength of 19,000 gauss. A. D.

2194. *Destruction of Phosphorescence Property by Pressure.* **P. Lenard** and **V. Klatt.** (Ann. d. Physik, 12. 2. pp. 439–441, Aug., 1903.)—Tafel has shown that white zinc oxide can be made to pass into a brown variety through pressure, and that this behaves in a different manner from the original substance with regard to phosphorescence under canal rays. [See Abstract No. 1119 (1904).] The authors now give instances which have come under their own observation, in which the phosphorescence property is entirely destroyed by pressure. R. S. W.

2195. *Radio-activity of Thorium Minerals.* **G. F. Barker.** (Amer. Journ. Sci. 16. pp. 161–168, Aug., 1903. Paper read before the National Academy of Sciences, April 22, 1903.)—Most of this paper consists in a summary of previous results. The chief fact that is novel is the author's contention that, contrary to the statement of Hofmann and Zerban [see Abstract No. 100 (1904)], radio-active thorium can be prepared from monazite sands that are quite free from uranium. The author considers, therefore, that the activity of thorium salts is primary and not induced—a contention that has since been disputed in a subsequent paper by Zerban. T. M. L.

2196. *Action of Radium on Globulin.* **W. B. Hardy.** (Chem. News, 88. p. 73, Aug. 14, 1903. Proc. Physiol. Soc., May 16, 1903.)—Globulin and, probably, the living tissues seem to be completely transparent to the electrons from radium bromide, and the emanations from it have apparently little effect, if any; but the positively charged particles of little penetrative power rapidly affect the solubility of globulin, which first clears up and then becomes opaque, all within about 3 min. A. D.

2197. *Radio-active Substances.* **W. Marckwald.** (Zeitschr. Elektrochem. 9. pp. 698–699, Aug. 20, 1903. Report read before the 10 Hauptversamml. d. Deutsch. Bunsen Gesell., June 3–8, 1903, at Berlin.)—With a few mgm. of substance obtained from 4,000 kg. of Joachimsthal pitchblende, the author demonstrated to a large audience the radio-active properties (phosphorescence, ionisation, discharge of electricity) of radiotellurium; he showed that quite similar experiments could be made with radium so long as the latter was not enclosed. Even the thinnest plate of mica cuts off the α-rays to such an extent as to make negligible the ionisation of air by the radium rays. D. H. J.

2198. *Action of Radium on Micro-organisms.* **A. B. Green.** (Roy. Soc., Proc. 73. pp. 375–381, May 28, 1904.)—The experiments were made with 1 c.gm. of radium bromide enclosed in a vulcanite and brass capsule with a talc window, the radiations which passed through the talc being used upon the micro-organisms at a distance of 1–2 mm. The purity and strength of the radium is referred to, with examples. The germicidal action was investigated in the case of calf vaccine and its extraneous bacteria, and also of a number of other micro-organisms, including various species of bacillus, the method of experiment being fully described. The results obtained showed that the specific germ of vaccine was destroyed in from 2 to 10 hours, the extraneous bacteria being destroyed in rather less time, in no case surviving longer than 15 hours. Spore-bearing bacteria, however, were much more resistant, not being killed by less than 72 hours' exposure, as was found by Pfeiffer and Friedberger [see Abstract No. 789 (1904)], asagainst 2–15 hours for the non-sporebearing bacteria. The induced radio-activity of the exposed bacteria was also examined, an image on a photographic plate being obtained after only 1 hour's exposure to the bacteria which had been killed by 24–120 hours' exposure to the radium, the best images being given by bacterial masses containing spores; and such radio-activity has continued for 3 months after exposure. Images were also obtained through 2 sheets of lead-foil. [See also Abstracts Nos. 102 and 770 (1904)]. L. H. W.

2199. *Pyroradio-activity.* **T. Tommasina.** (Archives des Sciences, 17. pp. 589–596, June, 1904. Communication from the Société de Physique et d'histoire Naturelle de Genève.)—Various observations on the radio-active properties of wires of different metals when heated to redness by an electric current. These tend to prove that all bodies possess more or less the property of radio-activity and emit electrified particles. J. J. S.

2200. *Scintillations Produced by Pitchblende.* **F. H. Glew.** (Röntgen Ray, Archives, 9. pp. 25–27, June, 1904.)—By using a transparent fluorescent screen the luminous effects produced by the α-rays have been observed direct from pitchblende and various other radio-active minerals. J. J. S.

2201. *Nature of the α-rays from Radium.* **H. A. Wilson.** (Nature, 70. p. 101, June 2, 1904.)—It is suggested that α-particles may be positive electrons having a radius about 2,000 times smaller than negative electrons. J. J. S.

2202. *Suggested Explanation of Radio-activity.* **J. H. Jeans.** (Nature, 70. p. 101, June 2, 1904.)—The author suggests that the atomic instability may be due to the agitation of the ultimate constituents of the ions or corpuscles. It may result from a rearrangement of an ether structure, and not solely of a material structure. J. J. S.

2203. *Blondlot's* N-*rays.* **J. B. Burke.** (Nature, 70. p. 198, June 30, 1904.)—The author has endeavoured to repeat Blondlot's experiment, in which the increase of brightness produced in a small spark by the *n*-rays was shown by the photographic effect, but has not obtained any difference in the photographic effects which could not be attributed to a spurious cause. J. J. S.

HEAT.

2204. *Temperature Variation of the Coefficient of Expansion of Nickel.* **E. P. Harrison.** (Phil. Mag. 7. pp. 626–634, June, 1904.)—The author observed the sudden change in the coefficient of expansion of a very pure nickel wire to occur between 365° C. and 370° C. The change was of the same magnitude whether the wire was heated or cooled, or after repeated heatings; and no permanent elongation occurred. The anomalous part of the curve extends from 340° C. to 370° C.—this also being the range in which changes occur in the thermoelectric force, resistance, and permeability of the same specimen. F. R.

2205. *Specific Heats of Certain Organic Solids.* **W. F. Magie.** (Phys. Rev. 16. pp. 381–382, June, 1903. Abstract of paper read before the American Physical Society, April 25, 1903.)—The author has determined the specific heats of a number of organic solids by introducing a weighed quantity into one of the cups of a Pfaundler calorimeter, the cups being filled with aniline or kerosene, of which the specific heats are 0·5155 and 0·4753 respectively. The figures obtained are given in the following table, together with the molecular heats and the heats of solution in gramme calories, of 1 gm. of each substance in 37·5 gm. water:—

	Specific Heat.	Molecular Heat.	Heat of Solution.
Cane sugar	0·301	103	— 3·6
Hydrated milk sugar A..........	0·299	107·6	— 11·5
Anhydrous milk sugar A.	0·2895	99	— 7·4
Maltose A.	0·323	116	— 9·75
Dextrose A.	0·314	56·5	— 13·02
Levulose K.	0·276	51·5	— 10·64
Mannite A.	0·316	57·5	— 28·2
Dulcite K.	0·283	51·5	— 36·7
Resorcin K.	0·266	29·2	— 34·09
Hydroquinone K..................	0·258	28·3	— 41·2
Pyrocatechin K.	0·313	34·4	— 31·34
Urea K.	0·321	19·2	— 60·4
Glycerin	0·576	53	+ 14·0
Phenol, liquid	0·561	52·7	— 30·6

The specific heats of the substances marked A were determined in aniline, those marked K in kerosene. The molecular heats observed are consistent with Staigmüller's theory as to the freedom of the molecules, on which theory the solution of non-electrolytes involves in most cases a considerable increase in the freedom of their atoms. W. H. St.

2206. *Specific Heats of Solutions.* **W. F. Magie.** (Phys. Rev. 17. pp. 105–116, Aug., 1903.)—The results of the author's measurements on various organic compounds show that in solution the molecular heats of isomers are not always the same. In most cases the apparent molecular heat of the substance is considerably increased when it goes into solution, urea being the only solid, of those examined, which is an exception to this rule. Liquid glycerine retains the same molecular heat when dissolved in water. Liquid phenol dissolves in alcohol without change, but its molecular heat is increased by solution in water. The author adopts the hypothesis that the process of solution, in the case of non-electrolytes, involves a loosening of the bonds which confine the atoms in the molecule, so that the increase in the molecular heat is due to an increase in the degrees of freedom of the atoms. From the observed molecular heats of the different substances are calculated the values of i in Staigmüller's formula: $\delta = a + 2i$, δ being a quantity the magnitude of which depends on the number of degrees of freedom possessed by the molecule and which, when multiplied by a constant ($\lambda = 0{\cdot}98835$), gives the molecular heat at constant volume; a represents the number of variable co-ordinates, at the most six in number, which determine the position of the molecule, and i the number of the co-ordinates which determine the position of the atoms in the molecule, and which are variable, and so determine the number of degrees of freedom possessed by the molecule owing to the peculiarities of its atomic structure. Apart from the sugars, the supposition that the atoms have each one degree of freedom leads to concordant numbers. With these substances in solution it is never necessary to assign more than three degrees of freedom to the atoms, so that these may be conceived of as material points; the differences between the molecular heats of isomerides may be ascribed to differences in the freedom of similar atoms. With liquid compounds the molecular heats at low temperatures may be described in most cases by assigning one degree of freedom to each atom of the molecule; as the temperature rises, the molecular heat changes owing to an increase in the degrees of freedom of their atoms. It is found that isomerides behave differently with respect to the heat developed by solution, just as they do as regards molecular heat; even resorcinol and hydroquinone, which are very similar in their specific heat relations, have different heats of solution. No general relation between the heats of solution and the estimated change in the number of degrees of freedom can be detected. T. H. P.

2207. *Thermochemistry of Rosaniline and Pararosaniline.* **J. Schmidlin.** (Comptes Rendus, 137. pp. 331–334, Aug. 3, 1903.)—The author gives results of his measurements of the heats of neutralisation of rosaniline and pararosaniline, which, owing to the slight solubility, were determined with solutions of dilute acids. It is found that, in addition to the thermal change due to neutralisation, a further heat change, sometimes positive and sometimes negative, takes place. This second phenomenon, which is accompanied by either a development or a destruction of colour, is probably due to hydration or dehydration. Thus the dissolution in acetic acid of the base of rosaniline gives rise to two thermal phenomena, corresponding with two distinct reactions taking place with different speeds, and an increasing red colour is formed. The first reaction, in which acetic acid is added to the rosaniline forming a colourless compound, develops 7·87 cals., whilst the second, which is one of dehydration and yields a coloured compound, absorbs 3·39 cals. With hydrochloric acid a coloured solution is first formed on dissolving the mono- or tri-hydrochloride in the acid, and the product then becomes hydrated yielding a colourless carbinol derivative. The thermal effects of these changes were measured. T. H. P.

2208. *Combustion of Carbon in Reductions by Means of Calcium Carbide.* **B. Neumann.** (Zeitschr. Elektrochem. 9. pp. 699–701, Aug. 20, 1903.)—

F. v. Kügelgen [see Abstract No. 1526 (1904)] has maintained that carbon dioxide is the direct product of the reduction of metallic oxides by means of calcium carbide, in contradiction to results previously obtained by the author. The latter now points out that the results obtained will depend on the equilibrium which exists between carbon dioxide, carbon, and carbon monoxide. In all cases a mixture of these substances will be produced, but the relative proportions of the components will depend on the temperature of the reaction. The equilibrium will also be affected by the presence of the metallic oxides and of the metals formed during the reduction, so that the proportions of the monoxide and dioxide of carbon produced will not exactly correspond with those obtained with the pure reaction mixture, $C : CO : CO_2$. The author has measured the temperature in the case of the reduction of lead monoxide, and finds that it is from 650–720° C.; at this temperature there must be an appreciable quantity of carbon monoxide in the gas mixture produced. At higher temperatures the proportion of carbon monoxide increases, and consequently 1 mol. of carbide will not be sufficient to produce 5 mols. of reduced metal, as v. Kügelgen maintains. T. S. P.

2209. *Specific Heats of Aqueous Solutions.* **G. Kalikinsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1215–1238, 1903.)—The author gives an account of previous investigations on the specific heat of aqueous solutions, and then describes his own calculation, made with the view of discovering a connection between the molecular weight of a substance in solution and the specific heat of a solution. The specific heat of a solution of x parts by weight of a substance in 100 of water may be expressed by the formula:—

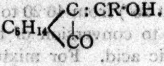
$$y = 1 - x/(100 + x) + c.x/(100 + x) \mp z.x/(100 + x),$$

where the specific heat of water is taken as 1, and that of the dissolved substance in the solid state denoted by c, while z represents the magnitude by which the specific heat of the solution is changed (relatively to the mean specific heat) by dissolving 1 cm. of the substance in a given quantity of water. When the specific heat of a solution is less than that calculated from the specific heats of its constituent parts, which is the case for the strong mineral acids and bases and their salts, the negative sign in the formula must be taken. The value of z depends on the concentration of the solution and on the nature of the dissolved substance, and may be expressed by the formula: $z = \alpha - \beta x/(100 + x)$. From the known data for solutions of a number of electrolytes, the values of α and β have been calculated, and also the values of αe (e being the equivalent weight of the substance dissolved), which expresses the diminution of the specific heat of water containing in solution the equivalent weight of any substance; tables are also given containing the observed values of the specific heats of solutions of various concentrations, together with those calculated from the above formula. The values of αe for potassium chloride, bromide, nitrate, sulphate, chromate, and carbonate, sodium chloride, nitrate, sulphate, and carbonate, strontium chloride, barium chloride, magnesium chloride and sulphate, and manganese chloride are all either exactly or very nearly 38; for calcium chloride, 37; for potassium iodide, sodium bromide or iodide, nitric acid, and ammonium sulphate, 36; for ammonium chloride, 34; for strontium nitrate and nickel sulphate, 33; for copper sulphate, 32; for ammonium nitrate, 31; for lead nitrate, taking e as the molecular weight, 38; and for sulphuric acid, taking e as the molecular weight, 22. By substituting the value of z in the above formula, it is seen that β is the coefficient of the term $[x/(100 + x)]^2$, which is very small, so that in general it may be taken that $ez = ae = 38$; equivalent qualities of electrolytes in high degrees of dilution hence diminish the specific heat of the water in which they are dissolved by a constant amount. The values of β also show certain regularities, and for a series of similar compounds, such as KCl, KBr, and KI or $CaCl_2$, $SrCl_2$, and $BaCl_2$, it seems probable that β has the value B/e^2, where B is a constant. From the results given, it is also seen that for one and the same salt in different concentrations, the value of ez increases with the dilution. The other substances investigated are the following: (1) Sucrose. In this case, $c = 0{\cdot}301$ and z is practically constant and equal to 0·128, so that the specific heat of the solutions is expressed by $y = 1 - 0{\cdot}571 \,.\, x/(100 + x)$. (2) Tartaric acid; $c = 0{\cdot}288$ and z is nearly constant, and $= 0{\cdot}090$, so that $y = 1 - 0{\cdot}622 \,.\, x/(100 + x)$. (3) Acetic acid; $c = 0{\cdot}4932$ and z diminishes, though but slightly, on dilution; $y = 1 - 0{\cdot}37 \,.\, x/(100 + x)$. T. H. P.

2210. *Properties of Mixtures of Nitric and Sulphuric Acids.* **A. V. Saposchnikoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1098–1112, 1903.)—In order to obtain some idea of the causes of the increased nitrating action of a mixture of nitric and sulphuric acids over that of nitric acid alone, the author has studied such mixtures under various physico-chemical aspects: (1) *Vapour Pressure.*—The measurement of the vapour pressures was made by passing a known volume of air through the mixtures and determining the amounts of nitric acid passing off with the air. The presence of 2·77 per cent. of sulphuric acid in a mixture of the acids lowers the vapour pressure of nitric acid (at 25°) from 46·20 to 41·24 mm.; this rapid fall the author considers to be due to conversion of the volatile nitric oxide into the non-volatile nitrosylsulphuric acid. For mixtures of the acids containing 95 to 80 per cent. of nitric acid, the vapour pressure remains almost constant, whilst from 70 to 30—25 per cent. the pressure falls from about 39 mm. to about 19·4—16 mm., the curve between these points being very nearly a straight line. At between 25 and 20 per cent. of nitric acid a point of inflexion occurs in the curve, which afterwards proceeds to the zero of pressure for pure sulphuric acid. Preliminary measurements of the vapour pressure of dilute nitric acid show that the presence of water (14—15 per cent.) in the acid causes a considerable diminution in its vapour pressure, which gradually increases when sulphuric acid is added, until when about 50 per cent. of this acid is present in the mixture the vapour pressure is almost doubled, and indeed about equal to the vapour pressure of pure nitric acid mixed with the same proportion of concentrated sulphuric acid. (2) *Composition of the vapours of mixtures of nitric acid with sulphuric acid.*—Determination of the composition of the vapours carried off from mixtures of nitric acid and sulphuric acid shows that the principal action of the sulphuric acid is that of removing excess of water from the nitric acid; any chemical action occurring is limited to the conversion of a portion of the nitric acid into the corresponding anhydride, and this only takes place in presence of a very large proportion of sulphuric acid. (3) *Specific gravity.*—This magnitude gradually increases by the addition to nitric acid of sulphuric acid until about 89 per cent. of the latter is present, when a maximum is reached; after this it falls to the value for pure sulphuric acid. This maximum value may be contributed to by two causes: firstly, a diminution of the number of molecules of nitric acid present, owing to the dehydration by the sulphuric acid, and secondly, the increase which is known to take place in the sp. gr. of sulphuric acid when small proportions of water are added to it. (4) *Electrical conductivity.*—The variation of the specific conductivity of mixtures of these acids with the proportion of sulphuric present is of a very complex character, the curve presenting a minimum, a maximum, and a point of inflexion. The curve for aqueous sulphuric acid is also given, and is likewise of a complex nature. T. H. P.

2211. *Chemical and Physical Properties and Constitution of the Acylcamphors.* **J. W. Brühl.** (Ber. Deut. Chem. Gesell. 37. pp. 761–773, 1904.)—The boiling-points of the series are :—

	Boiling-point.	Pressure.
Hydroxymethylenecamphor	105°	11·0 mm.
Acetylcamphor	118–118·5	11·2 „
„	127–128	15·5 „
Propionylcamphor........................	129	11·0 „
Butyrylcamphor...........................	132–133	11·2 „
„	134–135	12·0 „
iso-Valerylcamphor	141–143	11·0 „

Only the first member of the series is solid. The sp. gr., molecular volume, and refractive index for the three hydrogen lines and the D line, molecular refraction, and dispersion are tabulated in the original paper for acetylcamphor, propionylcamphor, butyrylcamphor, and *iso*valerylcamphor. The conclusion is drawn that all the members of the series exist exclusively, like hydroxymethylene camphor, in the keto-enolic form, as hydroxyalkylidene compounds,  $C_8H_{14}<\begin{matrix}C:CR\cdot OH\\ | \\ CO\end{matrix}$ T. M. L.

2212. *Influence of Temperature on the Solubility of Certain Compounds in Sulphur Dioxide.* **M. Centnerszwer** and **I. Teletoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 62–71, 1904.)—The authors have examined the solubilities, at different temperatures, of anthracene, anthraquinone, and quinol in liquid sulphur dioxide. The substance was heated with the dioxide in a thick-walled, sealed, glass tube, which was well shaken and the temperature noted at which the solid disappeared. At high temperatures, the solubilities increase very quickly, the curves being approximately asymptotic to lines parallel to the axis of solubility. On increasing the concentration of the solution by 1 per cent., its critical temperature is raised by 5°, so that, with these three substances, the solubility becomes infinitely greater before the critical temperatures of their saturated solutions are reached. The authors denote by "mean solubility" the relation $(s+\sigma)/(l+\lambda)$, where s and σ denote the quantities of the substance dissolved in the liquid sulphur dioxide (of weight l) and the vapour (of weight λ) respectively. By calculations based on the phase-rule, the conclusion is arrived at that the mean solubility of any difficultly volatile substance is not a constant magnitude at any particular temperature, but increases with an increase in the proportion of the tube filled with the liquid. Taking a tube filled to a certain fraction (0·26) of its volume with liquid sulphur dioxide, it is found that, if the concentration of anthraquinone is less than a certain limit (8·8 per cent.), the temperature of complete solution lies below that at which the meniscus disappears. If, however, the concentration of the anthraquinone solution in the tube equals or exceeds 8·8 per cent., the following four definite temperatures are observed : (1) Temperature at which the meniscus first disappears. (2) Temperature of reappearance of the meniscus. (3) Temperature of complete solution. (4) Temperature of the second disappearance of the meniscus. This phenomenon is one of "retrograde condensation" (condensation on heating and evaporation on cooling) taking place in a system of three phases and with a constant volume for the whole system. If 0·35 of the volume of the tube is filled with solution, similar retrograde condensation is observed, but this is not the case when the liquid occupies 0·41 or 0·51 of the enclosed volume, the temperature of complete solution then lying well below that at which the meniscus disappears. When the fraction reaches 0·61, the meniscus disappears at the upper end of the tube; if the concentration is less than 17 per cent., the temperature of solution is lower than that of the disappearance of the meniscus, but if more than 17 per cent. of the anthraquinone is present in the solution, the meniscus disappears at a lower temperature than that of complete solution. [See also Abstract No. 329 (1904).] T. H. P.

2213. *Temperature Effect in the Combination of Hydrogen and Chlorine under the Influence of Light.* **P. V. Bevan.** (Cambridge Phil. Soc., Proc. 12. pp. 398–405, April, 1904.)—For processes which are accelerated by light, the temperature coefficient of the velocity of reaction is smaller than for other reactions. In the combination of hydrogen and chlorine, investigated by the author between 11° and 60° by the method of Bunsen and Roscoe—using a constant light source—the vapour pressure of the water present, which conditions the combination of the two gases, rises rapidly with the temperature. The final rates of action determined are : At 11°, 22 ; at 12·5°, 24 ; at 30·5°, 31 ; at 33·5°, 32 ; at 35·5°, 33 ; at 46°, 38 ; at 50°, 48° and at 60°, 56. Van't Hoff's simple relation between temperature and velocity does not hold in this case. It is probable that the combination of hydrogen and chlorine is an irreversible action taking place by means of intermediate compounds, or at any rate, aggregates of molecules, the first step being the formation of groups involving chlorine and water molecules. T. H. P.

2214. *Heats of Combustion of Some Organic Compounds.* **E. Fischer** and **F. Wrede.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 20. pp. 687–715, April 14, 1904.)—The following are the molecular heats of combustion at constant volume in cals., determined by the authors by means of a slightly modified Berthelot bomb : benzoic acid, 775·3 ; naphthalene, 1237·5 : sucrose, 1363·9 ; phenylacetic acid, 933·4 ; glycine, 234·1 ; alanine, 390·3 ; leucine, 858·5 ; glycine anhydride, 476·7 ; alanine anhydride, 788·4 ; leucinimide, 1726·2 ; glycylglycine, 472·4 ; glycylglycine ethyl ester, 805·3 ; glycylglycinecarboxylic acid, 473·7 ; α-carbethoxyglycylglycine ethyl ester, 1123·2 ; β-carbethoxyglycylglycine ethyl ester, 1094·8 ; leucylglycylglycine, 1335·9 ; *iso*serine (β-aminolactic acid), 344·5 ; aspartic acid, 387·1 ; glutamic acid, 544·2 ; phenylglycine, 957·8 ; anilinoacetic acid, 967·9 ; benzoylaminocinnamic anhydride, 1858·3 ; benzoylaminocinnamic acid, 1854·5 ; benzoylphenylalanine, 1895·9 ; phenylalanine, 1114·1 ; barbituric acid, 360·7 ; diethylbarbituric acid, 985·9 ; silk fibroin, 5167·9 (cals. per gm.) ; 4-methyluracil, 567·7 ; 5-methyluracil (thymine), 566·4 ; 4-methylhydrouracil, 619·6 ; phenyluracil, 1134·9 ; hexoic acid, 839·6 ; hydrosorbic acid, 797·0 ; sorbic acid, 745·9. From the values for eight pairs of these compounds, it is found that the molecular heat of combustion increases by 155·9–158·1 cals. for each addition of CH_2. The increase for an addition of H_2 varies from 41·4 to 51·9 cals. The introduction of the NH_2 group causes an increase in the heat of combustion of 24·4, 28·6 and 29·3 cals., while the entrance of the phenyl group into a molecule brings about an increase of 723·8 cals. The formation of the anhydro-compounds, polypeptides and diketopiperazines, from amino-acids, is accompanied by absorption of heat. T. H. P.

2215. *Thermochemistry of Electrolytic Dissociation.* **C. J. Reed.** (Amer. Electrochem. Soc., Trans. 5. pp. 255–260; Discussion, pp. 260–272, 1904.)—J. W. Richards has advanced the view that the ionised state of a dissolved salt is a modified condition of the compound, and not one in which the compound is decomposed. In illustration of this view he has calculated the heat of formation of the ions from the elements in a number of cases, and the paper now under consideration is a criticism of the statements put forward by Richards. The criticism deals chiefly with the fact that the heats of formation considered were those of soluble salts only, an objection that appears to have very little importance in view of the fact that only the ionised state in solution was under consideration, and that the heat of dissolution of insoluble salts cannot be determined. More force attaches to the author's reference to the somewhat arbitrary value that has been assumed for the heat of formation of the mercuric ion, which forms the basis of the whole of the calculations. In further support of his theory Richards has argued that the heat of neutralisation of an acid by a base, does not represent the heat of formation of water, since both the hydrogen and hydroxyl ions are thermochemically in a combined state in the acid and alkali respectively. He considered, however, that it really represents the heat of conversion of the water from a dissolved or pseudo-gaseous, to a liquid state, and obtained a remarkable agreement between the observed values and those deduced, on the assumption that a molecule of water is condensed from a pseudo-gaseous state (under a pressure equal to the osmotic pressure of the solution) to a liquid state. This agreement is criticised by **H. A. Jackson,** who considers that the osmotic pressure has been wrongly calculated. T. M. L.

2216. *Thermoelectric Determination of the Reduction Temperature of Zinc Oxide.* **W. McA. Johnson.** (Amer. Electrochem. Soc., Trans. 5. pp. 211–217; Discussion, pp. 217–220, 1904. Paper read at Fifth General Meeting of the Amer. Electrochem. Soc., Washington, April 9, 1904.)—The author has determined the temperature of reduction of zinc oxide by solid carbon, using a cell of Acheson graphite heated in a reverberatory furnace. The cell consists of a piece of 4-in. round electrode, 4 in. long, in one end of which is drilled a hole 2½ in. deep, and fitted with a screw cover, also of graphite. A ¾-in. hole is also drilled in the lower part of the cell to receive the platinum-iridium pyrometer, ½ in. of graphite being left between this and the charge. Experiments with chemically pure zinc oxide and various ores, using charcoal, soft coke, and graphite as reducing material, show that the temperature of roasting affects the ease of reduction, and that different forms of carbon give different reduction temperatures, and consequently different rates of reduction. Thus for pure oxide reduced with 1,100° charcoal the reduction temperature is 1,022°, with soft coke 1,029°, and with graphite turnings 1,084°, while the temperatures for the various ores range from 1,029° to 1,120°. The boiling-point of cadmium determined in this apparatus is 756°, and its reduction temperature 767° with 600° charcoal, and 849° with graphite turnings.

It is suggested that the reduction is caused by the vapour pressure of solid carbon and the slight dissociation pressure of zinc oxide, tending to break up the zinc oxide into zinc and free oxygen. In the *discussion*, **J. W. Richards** considered the cell described would be of great use generally in electrochemical work. Carbon vapour, he believed, also played a part in the reduction of silica in a carborundum furnace. W. H. Si.

2217. *Boiling-point of Oxygen.* **A. Bestelmeyer.** (Ann. d. Physik, 14. 1. pp. 87–98, May, 1904.)—Employing a vessel in which liquid oxygen can be boiled by means of an internal electric heater, the vessel being protected from irregular external heat by immersion in liquid air, the author shows that when heat is supplied to the liquid by means of an electrically-heated spiral of tinfoil wound round the outer surface of the glass, considerable superheating, amounting to 2–5-tenths of a degree, occurs. The difference in temperature between liquid and vapour was determined by a differential platinum thermometer. The temperature of the vapour of the boiling oxygen was found, however, to be a definite function of the pressure. The measurements of this temperature agree as well as could be expected with those of Travers, Senter, and Jaquerod. [See Abstract No. 1025 (1903).] F. G. D.

2218. *Vapour Pressure of Mercury at Ordinary Temperatures.* **E. W. Morley.** (Phil. Mag. 7. pp. 662–667, June, 1904.)—The author has used a modification of van der Plaats' method, in which carbon dioxide was passed through a weighed quantity of mercury in such a way as to saturate it with the vapour. The volume of the gas when reduced to the temperature of the mercury gave the volume of the saturated vapour; the loss of weight by the mercury gave the weight of this saturated vapour. From this the vapour pressure may be calculated. The results given below were found to agree with those of Hertz and of Ramsay and Young, but they are considerably less than those of van der Plaats.

Temperature.	Vapour Pressure Observed.	Vapour Pressure Calculated $(p=ab^t)$.
°	mm.	mm.
0	—	0·0004
10	—	0·0008
16	0·0010	0·0012
20	—	0·0015
30	0·0027	0·003
40	0·0052	0·006
50	0·0113	0·011
60	0·0214	0·021
70	0·0404	0·040

E. S. A. R.

2219. *Specific Heat of Carbon at High Temperatures.* **L. Kunz.** (Ann. d. Physik, 14. 2. pp. 309–333, June, 1904. Extract from the Bonner Dissertation.)—An electrical resistance furnace of the Heräus type was used for heating the carbon, and a Bunsen ice calorimeter for measuring the specific heat. The high temperatures were measured with a thermo-element graduated up to 1,300° C. Full details of the construction and method of using the apparatus are given. Wood charcoal was used in the measurements. It was contained in a platinum capsule whose specific heat was determined by the same method. The specific heat s of charcoal at a temperature t is given by the expression $s = -0{\cdot}0498 + 0{\cdot}9714t/10^3 - 0{\cdot}7823t^2/10^6 + 0{\cdot}2236t^3/10^9$. This result is compared with previous researches. At 1,000° C. the value given by Weber is 0·379, by Violle 0·415, and by the author from the curve given or the above formula, 0·363. A short appendix to the paper describes an electrical resistance furnace, consisting of a carbon tube, which could be raised to 2,500° C. with a current of 25 amps. W. W. H. G.

2220. *Formation of Ozone at High Temperature.* **J. K. Clement.** (Ann. d. Physik, 14. 2. pp. 334–353, June, 1904. Göttinger Universitäts Institut für Physikal. Chemie.)—The stability of endothermic bodies increases with the rise of temperature, and it may therefore be expected that when oxygen is heated to a very high temperature it will be converted into ozone according to the equation, $3O_2 = 2O_3$. This is apparently supported by the published researches that are quoted. The present paper deals firstly with an attempt to form ozone at a temperature over 2,000° C. For this purpose use was made of Nernst's electrical resistance material. Oxygen was passed over the glowing material and then quickly cooled. For this purpose pure oxygen was obtained by the electrolysis of a 15 per cent. solution of caustic soda by means of nickel electrodes. No ozone was obtained in this manner. It was found necessary to avoid the introduction of nitrogen into the apparatus, which would result in the production of oxides of nitrogen having reactions like ozone. A second series of experiments was made by using an arc obtained by dividing the Nernst substance in the middle and separating the two halves about 1 mm. distance. No ozone resulted. Next a hollow tube of the Nernst material was used. The oxygen was driven through the hot tube and thence through a capillary tube of glass. No ozone could be detected in the issuing gas. The velocity of the decomposition of ozone was now considered. The decomposition may be represented by $O_3 = O_2 + O$, or $2O_3 = 3O_2$. It is agreed with Warburg that the reaction is a molecular one. The subject is considered very fully. Use is made of the relation of van't Hoff, and the experimental data obtained to show that at 1,000° C. the percentage of ozone will fall from 1 to 0·001 in 0·00067 sec., and will therefore decompose practically instantaneously. Hence at 2,000° C. with the quickest possible cooling it cannot be expected to detect any ozone. The production of ozone when an electric spark is used is thought to be possibly due to the action of the ultra-violet light. W. W. H. G.

2221. *Heats of Combustion of Polymerides and Isomerides formed by the Action of Light.* **C. N. Rüber** and **J. Schetelig.** (Zeitschr. Phys. Chem. 48. pp. 345–352, June 7, 1904. Paper read before the Gesellschaft der Wissenschaften, Christiania, Jan. 23, 1904.)—The yellow cinnamylidenemalonic acid is polymerised by light to white diphenyltetramethylenebismethylenemalonic acid, and cinnamic acid gives *a*-truxillic acid. The change brought about by light is accompanied by no energy-change, as the heat of combustion remains practically unaltered. The amounts of heat given out by the combustion of 1 gm. are: For the yellow acid, 6·056 cals., and for the white polymeride, 6·055 cals.; for cinnamic acid, 7·047 cals., and for *a*-truxillic acid, 7·039 cals. According to Baeyer's tension theory, the passage of two ethylene linkages into a tetramethylene ring should be accompanied by a considerable diminution of the tension, and hence by a loss of energy. Acrylic acid, on combustion, yields 4·571 cals. per gm. (liquid), the calculated value for the solid acid being 4·534 cals.; for the corresponding saturated acid of double the molecular weight Stohmann found 4·462 cals., so that here the energy-content is somewhat different in the two cases. According to Liebermann, allocinnamylidenacetic acid, under the influence of light, is converted into ordinary cinnamylideneacetic acid, these two compounds being related in the same way as maleic and fumaric acids. The allo-acid yields on combustion 7·586 cals., and the other 7·535 cals. per gm. This difference is of the same order of magnitude as that between either maleic and fumaric acids, or cinnamic and allocinnamic acids. T. H. P.

2222. *Dissociation, Thermochemistry, and Constitution of New Hydrochlorides of the Rosanilines.* **J. Schmidlin.** (Comptes Rendus, 138. pp. 1615–1617, June 20, 1904.)—The transformation of the red hydrochloride of rosaniline into a white salt, described in a previous paper [see Abstract No. 2360 (1904)], is shown to be completely reversible. In a sealed tube at the ordinary temperature the white product begins to fuse and become yellow, and by driving off the hydrochloric acid the colour changes to yellow, orange, red, brown, and finally the black colour of the trihydrochloride is reached, while by heating the latter one gets monohydrochloride. Experiments on the dissociation pressure do not reveal the formation of any definite compound during these changes except the triacid salt, but the solution of hydrochloric acid gas in the trihydrochloride interferes with the results. By measuring the heat evolved during the absorption of hydrochloric acid by pararosaniline and hexamethyl pararosaniline, the effect of the first molecule absorbed is found to be only about half that of the second, showing from the laws of thermodynamics that at first the gas is simply dissolved, but that when a certain concentration is reached, combination takes place. With both salts the maximum decolouration is obtained when eight molecules of hydrochloric acid have been absorbed, and since about one molecule is dissolved these compounds correspond to heptahydrochlorides. It is impossible to explain the formation of these compounds on the assumption that the salts are esters, without destroying the benzene ring, but adopting the view of Nietski, that they are quinone-like bodies, the explanation is simple, the additional four molecules of hydrochloric acid replacing the four double-linkages, and forming in the case of rosaniline, trihydrochloric of tetrachlor-cyclohexane-rosaniline. [See also Abstract No. 2207 (1904).] W. H. Si.

2223. *Relation between the Properties of Various Bodies as Cyclohexane Solvents and their Constants of Crystallisation.* **G. Bruni** and **M. Padoa.** (Accad. Lincei, Atti, 12. pp. 119–128, Aug. 2, and pp. 195–203, Sept. 6, 1903.)—The authors have determined the crystallisation constants of a large number of bodies, and compare these with their properties as cryoscopic solvents, arranging the substances in four classes according to their suitability for the latter purpose. They conclude (1) that the latent heat of fusion and the molecular depression have no influence on the usefulness of a substance as a cryoscopic solvent; (2) no general relation can be deduced between the properties studied and chemical constitution, though the aromatic hydrocarbons are, with the exception of triphenylmethane, first-class solvents, possess a high velocity of crystallisation, have well-defined melting-points, and only exist in one crystalline form; (3) the velocity of crystallisation of a body and number of nuclei formed determine to a very great extent its character as a cryoscopic solvent, the former property having the more influence, and substances with a high crystallisation velocity being generally the best, though those with a low velocity and large number of nuclei work well; (4) the results confirm Tammann's conclusion that with polymorphous bodies each modification has its own velocity of crystallisation, which may be greater for the stable or labile form indifferently; and (5) the existence of a substance in more than one form does not seem to influence the phenomena accompanying crystallisation. W. H. Si.

2224. *Theory of the Critical State.* **J. Traube.** (Phys. Zeitschr. 4. pp. 569–572, Aug. 1, 1903. Techn. Hochschule, Charlottenburg.)—The author quotes the work of P. Eversheim [see Abstract No. 1097 (1904)] as confirmatory of his theory, which supposes that both the co-volume and the actual molecular volume increases on evaporation. The point at which the gaseous and liquid phases have the same density lies above the Andrews critical temperature, and may coincide with the absolute evaporation point discussed before. Teichner's work [see Abstracts Nos. 1453 and 1981 (1904)] is also adduced. H. H. F. H.

2225. *Liquefied Hydrides of Phosphorus, Sulphur, and the Halogens as Conducting Solvents.* Part I., **D. McIntosh** and **B. D. Steele**; Part II., **E. H. Archibald** and **D. McIntosh.** (Roy. Soc., Proc. 73. pp. 450–455, June 22, 1904.)—The following are the freezing- and boiling-points of the liquid hydrides:—

	HCl.	HBr.	HI.	H_2S.	H_3P.
Freezing-point........	—	− 86·0°	− 50·8°	—	—
Boiling-point	− 82·9°	− 68·7°	− 35·7°	− 60·1°	− 86·2°

and the following their vapour pressures at various temperatures:—

HCl	Temp.	− 109·9°	− 101·3°	− 92·9°	− 85·9°	− 80·5°
	Press.	141 mm.	245	430	648	868
HBr	Temp.	− 104·2°	− 96·3°	− 87·1°	− 76·7°	− 68·4°
	Press.	96 mm.	185	284	501	775
HI	Temp.	− 77·9°	− 68·4°	− 59·5°	− 47·7°	− 35·9°
	Press.	74 mm.	126	224	438	769
H_2S	Temp.	− 84·0°	− 78·4°	− 73·3°	− 69·1°	− 62·2°
	Press.	193 mm.	270	364	456	676
H_3P	Temp.	− 105·9°	− 101·2°	− 97·7°	− 93·1°	− 86·6°
	Press.	237 mm.	319	393	498	719

The densities of the liquids at their boiling-points are—

HCl.	HBr.	HI.	H_2S.	H_3P.
1·195	2·157	2·799	0·964	0·744

From the measurements of the surface-energy by a modification of Ramsay and Shields' method, it is found that HBr, HI, and H_2S are normal liquids, whilst HCl (association factor, 1·5) and H_3P (1·4) associate slightly. The viscosities of the liquids are given with reference to that of distilled water at 22°; the temperature coefficients of the viscosity are: HCl, 0·88; HBr, 0·57; HI, 0·70; and H_2S, 1·10. No metallic salt dissolves in these hydrides in more than traces, but a number of organic compounds are soluble, *e.g.*, amine salts, acid amides, certain nitrogenous alkaloids, alcohols, ketones ethers, phenols, acids, and esters. In every case where a conducting solution is formed, the dissolved substance contains an element the valency of which may increase, namely, sulphur, oxygen, or nitrogen. The following table gives some of the conductivity measurements, C being the concentration in gm.-mols. per litre and λ the conductivity in reciprocal ohms $\times 10^{-6}$:—

	Solvent.	C.	λ.
Acetamide	HBr	0·011	65·2
„	„	0·713	3155·0
Acetonitrile	HCl	0·0463	1512·0
„	„	1·232	9636·0
Ethyl oxide	HI	0·10	12·5
„	„	1·14	2208·0
Triethylammonium chloride	H_2S	0·014	117·0
„ „	„	0·401	1580·0

In the majority of cases the temperature coefficient of the conductivity is positive. All the experiments made indicate that, in these solutions, it is the dissolved substances which carry the current and not the solvent. T. H. P.

2226. *Alloys of Copper and Antimony and the Phenomenon of Recalescence observed in them.* **A. A. Baikoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 111–165, 1904.)—The author has prepared melting-point curves and tables of alloys of copper and antimony, and also their cooling curves. The latter show that these alloys exhibit the phenomenon of recalescence. Copper and antimony form two compounds, $SbCu_2$ and $SbCu_3$. The violet alloy, $SbCu_2$, melts and decomposes at 516°, and can be prepared by melting $SbCu_3$ and antimony together in such proportions that solidification begins at a temperature below 586°; mixtures of the two metals, which commence to solidify at higher temperatures than 586°, deposit only the alloy $SbCu_3$, which melts at 681°. These results are in accord with those given by a study of the other physical properties of these alloys—hardness, expansion, and e.m.f. in galvanic elements. The alloy $SbCu_3$ exists in two modifications: (1) The α-form, stable at temperatures below 407°, and (2) the β-form, stable at higher temperatures. All mixtures of the two metals containing from 53·5 to 61 per cent. of copper, and consisting of mixed crystals of antimony and the compound $SbCu_3$, undergo, on cooling, two distinct changes: (1) Polymorphic transformation of the β-form of $SbCu_3$ into the α-modification, and (2) separation of $SbCu_2$. The micro-structure of the different alloys confirms the above conclusions. T. H. P.

2227. *Alloys of Copper and Arsenic.* **A. H. Hiorns.** (Electro-Chemist, 3. pp. 648–655, April; Discussion, pp. 734–736, May, 1904. Paper read before the Faraday Soc., April 13, 1904.)—The author gives the freezing-point curve for alloys of copper and arsenic, and also a number of microscopic pictures of the alloys. In nearly all cases the microscopic evidence confirms the information given by the freezing-point curve, which consists of four branches. The addition of arsenic lowers the melting-point of copper uniformly down to about 14 per cent., when a steep fall occurs, reaching its lowest point at 685° C. This alloy contains 19·2 per cent. of arsenic, corresponding with the formula Cu_5As_2. The alloy with 22 per cent. of arsenic freezes at 708°, and the curve gradually rises until the alloy with 28·34 per cent. is reached at 747°; this is the compound Cu_3As and is distinguished by several characteristics evidenced by the microscopic appearance. At 807° another chemical compound, Cu_5As_2, freezes; it is a well-defined substance, as is shown by its colour, fracture, melting-point, and internal structure, and it solidifies wholly at one temperature like a pure metal. Beyond this the temperature falls to a minimum, then rises to another summit at 740°, corresponding with the compound Cu_2As. Thence the curve descends to 702°, for the alloy containing **41** per cent. of arsenic, which is nearly the practical limit of the direct combination of copper and arsenic. T. H. P.

2228. *C_v in Liquids, and the* a *of van der Waals for Water.* **E. H. Hall.** (Phys. Rev. 17. pp. 122–123, Aug., 1903.)—The author deduces the following expression for C_v in terms of C_p, the coefficient of expansion at constant pressure (e), the coefficient of compressibility at constant temperature (k), the specific volume (v), and the absolute temperature (T):—

$$C_v = C_p - \frac{e^2vT}{k}, \text{ or } C_v = C_p + \frac{\left(\frac{dv}{dT}\right)_p^2}{\left(\frac{dv}{dp}\right)_T} \cdot T \quad \ldots\ldots\ldots \quad (1)$$

Applying this formula to the case of water at temperatures above 4° C., we find that C_v is less than C_p. By imagining unit mass of a liquid put through a very small cycle consisting of an isothermal, an isopiestic, and an isometric, it is easy from equation (1) to derive the following expression for ΔE (the internal latent heat of expansion at constant temperature) through a small increase of volume Δv; $\Delta E = (eT/k - p)\Delta v$. If, now, we assume that ΔE is merely the work of overcoming molecular attraction, and that, as in van der Waals' theory, this attraction is expressed by a/v^2, where a is a constant, we can find a value of a in the case of an expanding liquid by means of the equation, $\Delta E = (eT/k - p)\Delta v = a\left\{1/v - 1/(v + \Delta v)\right\}$. If, from the value of a given by this equation at 15° C., we calculate the amount of energy required to overcome the molecular attraction in the evaporation of water at this temperature, we find that only about one twenty-fifth part of λ, the internal latent heat of evaporation, is thus accounted for. At 50° C., one-sixth is accounted for, and at 100° C. nearly one-third. At the critical temperature the discrepancy should, apparently, entirely disappear. T. H. P.

2229. *Remarks on the Theory of Non-dilute Solutions.* **J. J. van Laar.** (Archiv. Musée Teyler, 8. 3. pp. 299–334, 1903.)—After giving a brief recapitulation of the deduction of the laws of non-dilute solutions from the general thermodynamical theory, the author arrives at the series-development, $f = ic + \Theta(ic)^2 + \omega(ic)^3 + \&c.$, where i = van't Hoff's factor, c = molecular concentration, Θ, ω, &c., are coefficients depending on the temperature and on the properties and molecular state of solvent and solute, $f = \psi_c - \psi_o$, where ψ_c and ψ_o are the thermodynamic potentials per gm. molecule of the solvent in solutions of concentrations equal to c and o respectively. By means of the relations $\log p_o/p = f$ (applicable to the lowering of vapour pressure), $a = \mu_c/\mu_\infty$, $i = 1 + a$, the author proceeds to calculate the first few terms in the series for f, using the data of Smits, Raoult, and Kohlrausch. It is found that the experimental data can be fairly well represented by a series of the form $f = ic + \Delta(ic)^{\frac{3}{2}} + \Theta(ic)^2 + \&c.$ This applies also to the case of a non-electrolyte such as cane sugar, if we put $i = 1$. In a future paper the author proposes to discuss the appearance of the term $\Delta(ic)^{\frac{3}{2}}$, which was not to be foreseen from the thermodynamical theory. F. G. D.

2230. *Influence of the Change of Specific Heat on the Work done in a Transition.* **J. H. van't Hoff.** (Boltzmann Festschrift, pp. 233–241, 1904. Zeitschr. Elektrochem. 10. pp. 640–642, Aug. 19, 1904. Abstract.)—Taking the change of specific heat accompanying a transition into account [see Richards, Abstract No. 673 (1903)], the influence of temperature on the work done in the transition may be expressed by the following equation:—

$$E = E_0 + AT - ST \log T,$$

where E is the free energy at the temperature T, E_0 that at absolute zero, S is the difference of the specific heats of the system before and after transition, A is an integration constant. From the above, it follows that $dE/dT = A - S(1 + \log T)$, and where the change or transition takes place without alteration of concentration, as in the case—

$$Mg + ZnSO_4, aq = Zn + MgSO_4, aq, \quad dE/dT = -S(1 + \log T).$$

For 18°, this leads to $dE/dT = -6{\cdot}7\,S$, and the author shows that this relationship is approximately fulfilled in a number of cases. In the change of liquid $\longrightarrow$ solid, or in other transitions which take place at a definite temperature, A cannot be neglected, but further consideration of the equations shows that for the possibility of a transition of any kind S must be > 0, that is, the form which is stable at higher temperatures must have the greater specific heat. This is known to be the case for every change liquid $\longrightarrow$ solid and for the majority of transition changes among elements or compounds exhibiting polymorphism. The exceptions among the latter may be due to incorrect determinations of the specific heats. The equation given above permits also the general conclusions that at low temperatures those systems are stable the formation of which is accompanied by development of heat, whilst at high temperatures only those heat-absorbing reactions will take place which yield products with higher specific heat.

L. H. W.

2231. *Available Energy in the Case of some Technically Important Reactions.* **H. v. Jüptner.** (Zeitschr. Anorg. Chem. 39. 1. pp. 49–68, March 15, 1904. K. K. Techn. Hochschule, Wien.)—From existing data the author calculates the decrease of free energy as a function of temperature and partial pressures in the case of the following reactions: $H_2 + O = H_2O$, $C + O_2 = CO_2$, $CO + O = CO_2$, $C + O = CO$. The following is an outline of the method employed: Using van't Hoff's equation, $d \log K = -q_T \dfrac{dT}{RT^2}$, and the relations $q_T = q_0 + (c_{II} - c_I)T$, $c_{II} = \alpha_2 + \beta_2 T + \gamma_2 T^2$, $c_I = \alpha_1 + \beta_1 T + \gamma_1 T_1^2$, we can integrate and express log K as a function of T. Since A_T, the decrease of free energy at temperature T (supposing all the gases taken at atmospheric pressure), is equal to RT log K, we can now express A_T as a temperature-function. Neglecting the relatively unimportant coefficients γ_1 and γ_2, we thus obtain, $A_T = A_0 + BT - 2{\cdot}30259(\alpha_2 - \alpha_1)T \log T - (\beta_2 - \beta_1)T^2$; $A_0 = q_0$, and β can be calculated if we know the value of A_T at any particular temperature. In the case of the reaction $H_2 + O = H_2O$, A_T can be calculated at 25° C. from Bose's measurements of the e.m.f. of the H_2-O_2 gas cell. In this way is found for this reaction—

$$A_T = 59506{\cdot}4 - 47{\cdot}74T + 7{\cdot}48T \log T - 0{\cdot}0020T^2.$$

If we are dealing with hydrogen, oxygen, and water vapour at the partial pressures P_{H_2}, P_{O_2}, and P_{H_2O} respectively, the term $4{\cdot}56\,T \log \frac{P_{H_2}P_{O_2}^{\frac{1}{2}}}{P_{H_2O}}$ must be added. The other reactions are dealt with similarly. F. G. D.

2232. *Slope of the Vaporisation Neutral Curve.* **J. E. Trevor.** (Journ. Phys. Chem. 8. pp. 341–350, May, 1904.)—In any graphical representation the "neutral" curve (Natanson) is a curve which separates the biphasic field into two portions, in one of which adiabatic expansion induces evaporation, in the other condensation. The author obtains general expressions for the slopes of this curve in the various diagrams formed by taking as rectangular co-ordinates any pair of state-variables from either of the sets (p, V, H, M_2), or (θ, V, H, M_2), where p = pressure, θ = temperature, V = total volume, H = total entropy, m_2 = mass of one of the coexistent phases. All this refers to the liquid-vapour equilibria of a one-component system. The paper is illustrated by a figure. F. G. D.

2233. *Possible Forms of the Fusion Curves of Binary Mixtures of Isomorphous Substances.* **J. J. van Laar.** (Archiv. Musée Teyler, 8. 5. pp. 517–579, 1904.) —A *résumé* of this memoir appeared already in the paper dealt with in Abstract No. 322 (1904). Setting out from the expressions already deduced (Kon. Akad. Wet., Amsterdam, p. 579, Feb. 11, 1903) by the author for the molecular thermodynamic potentials of the components of a liquid mixture and applying these in a simplified form to isomorphous crystalline mixtures regarded as solid solutions, the author gives a detailed discussion of the form of the above curves. It is shown that the curves both for the solid and liquid phases are really continuous, the apparent breaks or discontinuities observed experimentally being due to the fact that under certain conditions a portion of these curves will apply to labile states. These labile states will appear when the heat of mixture in the solid phase possesses a relatively great value. A eutectic point, and an apparent discontinuity in the series of solid solutions (crystalline isomorphous mixtures), are, therefore, compatible with complete isomorphism of the components. This paper is an important contribution to the thermodynamical theory of solid solutions. F. G. D.

2234. *Crystallisation in Three-Component Systems.* **W. C. Geer.** (Journ. Phys. Chem. 8. pp. 257–287, May, 1904.)—A discussion of the phenomena of isothermal crystallisation by means of the triangular diagram. After a lengthy examination of all possible cases (so far as solid phases consisting of single or double salts are concerned), the results are applied to discuss some already well-known instances, such as $CuCl_2 - KCl - H_2O$, $MgSO_4 - H_2SO_4 - H_2O$, $FeCl_3 - HCl - H_2O$. No mention is made of van't Hoff, though it is stated that "in *some* instances crystallisation experiments have been made and published, and the data rendered available for study. The systematic elaboration of the theory of phase separation has never been carried out." As might be expected, therefore, all the author's conclusions have been already arrived at by van't Hoff, and explicitly stated in various papers published by him and his pupils. [It is extremely regrettable that this sort of thing should be allowed to occur in what is presumably a serious publication.] F. G. D.

2235. *Stability of Equilibrium of a Homogeneous Phase.* **P. Saurel.** (Journ. Phys. Chem. 8. pp. 325–334, May, 1904.)—This paper gives a useful discussion of that difficult section of Gibbs' work in which the criteria of stability for a homogeneous phase are established. As the author states, his demonstrations, though different in form, are in substance the same as those of Gibbs. Nevertheless, there are very many to whom the author's discussion will be exceedingly welcome. F. G. D.

2236. *Congruent and Incongruent Melting of Double Salts.* **W. Meyerhoffer.** (Zeitschr. Phys. Chem. 48. pp. 109–112, May 10, 1904.)—If a double salt $\overline{AB}$ melts with separation of one component (B), the fused mass is incongruent (A > B), and cannot be prepared by melting together $\overline{AB}$ and B; at lower temperatures a congruent mass, $\overline{AB} + A$, exists. The dehydration of ordinary hydrates may be regarded as an incongruent fusion of a double salt, and the separated salt may be either an anhydride or a lower hydrate. The congruent melting-point is the cryohydric temperature. The second case, where the double salt melts undecomposed and gives three congruent fusions, is also exemplified by hydrates, *e.g.*, by calcium chloride with $6H_2O$, or $4H_2O$ or ice. With alloys, *e.g.*, sodium amalgam, incongruent fusions are also known. [See also Abstract No. 104 (1902).] T. H. P.

2237. *Theory of Diminishing Entropy.* **S. H. Burbury.** (Phil. Mag. 8. pp. 43–49, July, 1904.)—A discussion of thermodynamic views on the point in which it is concluded that—(1) if a material system consist of parts, the motions of which are separately reversible, it is impossible to prove that the motion of the aggregate is irreversible without making some physical assumption to be used in support of the pure mathematical theorem, (2) that such an assumption to be admissible must be mathematically possible and must be at least not inconsistent with experience, (3) that Boltzmann's assumption, the condition of independence, is not mathematically possible, at least as an accurate proposition. J. W. P.

REFERENCES.

2238. *New Form of Platinum Thermometer.* **H. T. Barnes** and **D. McIntosh.** (Phil. Mag. 6. pp. 350–352, Sept., 1903.)—One of the difficulties to be overcome in constructing a sensitive platinum thermometer is to restrict the size of the coil of wire forming the bulb. In order to have a sufficient length of wire it is often necessary to make the bulb inconveniently large, and thereby to sacrifice quickness of register. In the form devised by the authors the wire is wound outside a glass tube which at one end is fused to a wider concentric tube. The substance whose temperature is required can thus be made to circulate down the inner and round the outer tube; quickness of register is thereby attained. R. S. W.

2239. *Specific Heats of Aluminium and its Solid Salts.* **E. Baud.** (Journ. de Physique, 2. pp. 569–573, Aug., 1903.)—Results are given of measurements of the specific heats of aluminium (atomic heat = 5·805 between + 15° and + 52°) and a number of its salts. T. H. P.

2240. *Freezing-points of Dilute Solutions.* **T. W. Richards.** (Zeitschr. Phys. Chem. 44. pp. 563–570, Aug. 4, 1903.)—The author proposes various forms of apparatus, in which, with the aid of considerable quantities of ice, equilibrium is quickly attained. The method is sufficiently exact to be utilised for the calibration of thermometers. Reference is made to Jones, Loomis, Nernst, Abegg, Raoult, and Roloff, and particularly to Beckmann's apparatus. H. B.

2241. *Liquid Baths for Melting-point Determinations.* **H. Scudder.** (Chem. News, 88. pp. 104–105, Aug. 28, 1903. American Chem. Soc., Journ. 25. No. 2.)—A mixture prepared by boiling together for five minutes seven parts by weight of sulphuric acid (sp. gr. 1·84) and three of potassium sulphate remains transparent at ordinary temperatures and boils above 325°. With six of the acid to four of the sulphate the mixture forms a soft mass at ordinary temperatures (though after boiling and cooling it usually remains liquid for half an hour), melting at 60–100° and boiling above 365°. For temperatures from 365° to 600° fused zinc chloride forms the most satisfactory bath. T. H. P.

2242. *Heat of Combustion of Hydrogen.* **W. G. Mixter.** (Amer. Journ. Sci. 16. pp. 214–228, Sept., 1903.)—The bomb method (explosion of hydrogen and oxygen) is employed. The values found range from 33,702 to 34,483 calories. Comparison with the result of other observers is given. J. W. P.

2243. *Vapour Density of Hydrofluosilicic Acid.* **E. Baur** and **A. Glaessner.** (Ber. Deut. Chem. Gesell. 36. pp. 4215–4218, 1903.)—The volume of a weighed amount of hydrofluosilicic acid was measured at various pressures and temperatures of 23°, 31·5°, and 42°. The observed molecular weight was, roughly, 80, showing that more than half of the hydrofluosilicic acid was dissociated. L. H. W.

2244. *Density of Nitrogen at the Temperature of Liquid Air.* **A. Bestelmeyer** and **S. Valentiner.** (Kais. Akad. München, Sitzungsber. pp. 743–755, 1903.)—Density determinations have been carried out at temperatures between 81° and 85° absolute, and under pressures varying from 160 to 1,320 mm. of mercury. With the help of a coefficient of expansion the observations have been reduced to the two temperatures 81·4° and 85° absolute. At each temperature the product pv diminishes as p increases, the relation between these two quantities being a linear one. [See also Abstract No. 1697 (1904).] L. H. W.

2245. *Mixtures of Picric Acid and Naphthalene.* **A. V. Saposchnikoff** and **W. Rdultowsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1073–1074, 1903.)—The authors have determined the melting-point curve of mixtures of picric acid and naphthalene. Starting from 80°, the melting-point of pure naphthalene, the curve falls to a eutectic point 77·5° for a mixture containing 12·3 per cent. (mols.) of picric acid; it then rises continuously to 149·5°, when the mass contains molecular proportions of the two constituents. After this it falls to another eutectic point, 115°, the percentage (mols.) of naphthalene being then 8·59; finally, it rises to 122·5°, the melting-point of picric acid. A molecular compound, melting at 149·5°, of naphthalene and picric acid is thus formed, and this may be also obtained by mixing the two constituents in molecular proportions in alcoholic solution. The points 77·5° and 115° correspond with eutectic mixtures of the molecular compound and naphthalene and picric acid respectively. T. H. P.

2246. *Cooling Power of a Slightly Conducting Stream.* **J. Boussinesq.** (Comptes Rendus, 138. pp. 1134–1138, May 9, and pp. 1189–1194, May 16, 1904.)—The cooling effect of a stream upon a body of limited dimensions is found to be proportional to the excess of temperature of the body and to the square roots of the conductivity of the fluid, its specific heat per unit volume and its speed. For bodies that are similar and similarly placed with respect to the stream it is also proportional to their volume. R. E. B.

2247. *Mixtures of 2 : 4-Dinitrophenol and Naphthalene.* **A. V. Saposchnikoff** and **P. Helwig.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1075–1084, 1903.)—The melting-point diagrams and tables for mixtures of 2 : 4-dinitrophenol and naphthalene show that these substances unite in molecular proportions to form a compound which melts at 91·7° ; this melting-point is lowered by the addition of either of the constituent compounds. Besides the first solidifying point, all mixtures of 2 : 4-dinitrophenol and naphthalene have a second, which is that of complete solidification, and has the same value for mixtures containing the same proportion more or less than 50 per cent. (mols.) of the dinitrophenol ; hence these compounds do not form solid solutions, but, from molten mixtures of them, the constituent which is present in excess first crystallises out, and, when the liquid has reached the eutectic composition, crystallisation of the second constituent begins. T. H. P.

2248. *Mixtures of* o-*Nitrophenol and Naphthalene.* **A. V. Saposchnikoff** and **P. Helwig.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1084–1097, 1903.)—Melting-point curves and tables of mixtures of *o*-nitrophenol and naphthalene show that these compounds dissolve one another in the liquid state, but do not form solid solutions. The melting-point curve consists of two parts, which meet in a eutectic point at about 29·7°, corresponding with a mixture containing 67·2 per cent. (mols.) of the nitrophenol. On comparing the curves for mixtures of naphthalene with picric acid, 2 : 4-dinitrophenol [see preceding Abstract, and No. 2245 (1904)], or *o*-nitrophenol, it is seen that a fall in the number of nitro-groups in the substituted phenol shows itself in the character of the diagram obtained. The formation of a molecular compound of naphthalene and 2 : 4-dinitrophenol is not so clearly indicated in the melting-point curve as in the case of picric acid. T. H. P.

2249. *Mixtures of Trinitrocresol and Naphthalene.* **A. V. Saposchnikoff** and **W. Rdultowsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1097–1098, 1903.)—Mixtures of trinitrocresol and naphthalene give a melting-point curve similar to that obtained with picric acid and naphthalene [see Abstract No. 2245 (1904)]. The molecular compound formed, which melts at 124·5°, may also be prepared by mixing the constituents in alcoholic solution. T. H. P.

2250. *The Theory of Dissipation of Energy.* **K. v. Wesendonck.** (Phys. Zeitschr. 4. pp. 589–592, Aug. 15, 1903.)—This paper contains a *résumé* of the works of Helmholtz, Clausius, Thomson, Tait, and other writers, on the theory of thermodynamics in relation to the Carnot cycle. It has to do with the theory as founded on experiment, and not with the supposed purely mathematical, irreversible processes established by Boltzmann in his H theorem and by his followers, which depend on a great assumption. S. H. B.

2251. *Mechanical Model to Illustrate the Gas Laws.* **F. B. Kenrick.** (Journ. Phys. Chem. 8. pp. 351–356, May, 1904.)—An ingenious contrivance wherewith students can make themselves familiar with isothermals, isentropics, Carnot cycles, &c. F. G. D.

2252. *Certain Classes of Isothermal Surfaces.* **L. Raffy.** (Comptes Rendus, 138. pp. 1681–1684, June 27, 1904.)—Some mathematical properties of certain classes of isothermal surfaces are here considered. R. E. B.

2253. *van der Waals' Equation of State.* **P. Kohnstamm.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 794–807, May 27, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, April 23, 1904.)—[See Abstract No. 1458 (1904).]

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

2254. *Field of a Moving Electron.* **A. Sommerfeld.** (Gesell. Wiss. Göttingen, Nachr. Math.-Phys. Klasse, 2. pp. 99–130, May 20, 1904.)—A highly analytical paper dealing with the scalar potential ϕ of the electron and also with the vector potentials A_1 and A_2, due respectively to its motions of translation and rotation. The chief results may be summarised as follows: (1) The scalar potential ϕ at a sufficient distance and at time t can be calculated as though the electron had remained at the place it occupied at the time $t-\tau_0$, but its charge ϵ must be reduced in the ratio $1:\left\{1-\frac{v_0}{c}\cos(R_0, v_0)\right\}$. (2) The vector potential A_1 can be reckoned as for an element of current which in respect to place and direction corresponds with those of the electron at time $t-\tau_0$, the current in the element (electrostatically measured) must not, however, be written $\epsilon v_0/c$, but be reduced in the ratio above mentioned. (3) The vector potential A_2 and the corresponding magnetic field may be written equal to the field of an elementary magnet which is situated at the place occupied by the electron at $t-\tau_0$, the magnetic axis of this elementary magnet being defined by the vector B, its magnetic moment depending on charge, radius, and angular velocity of the electron, the charge being, however, reduced in the ratio before mentioned. E. H. B.

2255. *Effect of Magnetic Field on Electric Displacement Current.* **J. B. Whitehead.** (Phys. Zeitschr. 5. pp. 300–302, June 1, 1904. Translated from the English.)—Continuation of the author's attempt to demonstrate directly by experiment the fact assumed by Maxwell, that an electric displacement current experiences in a magnetic field a force of the same magnitude as that experienced by the corresponding conduction current [see Abstract No. 241 (1903)]. In all the experiments which are described, a portion of a dielectric is placed in the electric and magnetic fields which are at right angles to each other, both of which are alternating with the same frequency. The author attempts to observe the mechanical force on the dielectric, but in no case is such force observable. It is pointed out by F. Koláček [see Abstract No. 1166 (1904)] that the force is neutralised by another which is due to the electric field and the varying magnetic induction, or magnetic displacement current. The author expresses his intention of continuing to experiment by seeking the latter effect by using a constant electrical field and an alternating magnetic field and employing a ballistic method. S. G. S.

2256. *Electric Effect of Rotating a Dielectric in a Magnetic Field.* **H. A. Wilson.** (Roy. Soc., Proc. 73. pp. 490–492, June 22, 1904. Abstract.)—It was shown by Faraday in 1831 that an electromotive force is induced in a conductor when it moves in a magnetic field so as to cut the lines of force. The object of the present research was to see if a similar electromotive force is induced in a dielectric when it moves in a magnetic field. According to Maxwell's electromagnetic theory, as developed by H. A. Lorentz and Larmor, such an electromotive force should be induced in a dielectric and of amount $(1 - K^{-1})$ times that in a conductor, K being the permittivity of the dielectric. The method employed was to rotate a hollow cylinder of ebonite in a magnetic field parallel to the axis of the cylinder. The inside and outside surfaces of the cylinder were provided with metal coatings with which electrical contact was made by sliding brushes. The inside coating was to earth and the outside to one pair of quadrants of a sensitive electromotive The magnetic field was then reversed, so reversing the induced electromotive force in the ebonite. The mean result obtained for the quantity of electricity set free on the outside coating of the cylinder, on reversing the magnetic field, only differs by 1 per cent. from the amount calculated theoretically. From the experiments it is concluded that—(1) A radial electric displacement is produced in a dielectric, such as ebonite, when it is rotated in a magnetic field parallel to the axis of revolution. (2) The direction of the displacement is the same as that produced in a conductor. (3) The displacement is proportional to the magnetic field and to the rate of revolution. (4) The amount of the displacement agrees with that calculated on the assumption that the induced e.m.f. in the dielectric is equal to that in a conductor multiplied by $(1 - K^{-1})$. (5) The results are thus in complete agreement with the theories of Lorentz and Larmor, and may be regarded as a confirmation of them.

E. H. B.

2257. ***Radio-activity and Electrification at the Temperature of Liquid Air.*** **L. Bleekrode.** (Ann. d. Physik, 12. 1. pp. 218–223, July 21, 1903.)—A rod covered with polonium is dipped into liquid air. On removal it is placed near a charged electroscope, which is discharged as quickly as though the polonium were at the ordinary temperature. The influence of the emanation of phosphorus on the electroscope was found to disappear at the temperature of liquid air, as did the phosphorescence, the reason probably being that oxidation products are not formed at this temperature. The luminescence of calcium and zinc sulphides has ceased at — 191°, but recommences when the substance regains its ordinary temperature. The author applies the name "cryoelectric phenomena" to the production of electricity by cooling on immersion in low-temperature liquids, and his experiments point to different conclusions to those of Ebert and Hoffmann [see Abstract No. 2201 (1900)]. He finds that a sheet of aluminium is not charged by immersion in liquid air. Only when floating ice crystals are visible on the liquid is the substance found to be electrified on withdrawal, and it is concluded that electrification is due to friction with these ice crystals. Many crystalline substances are strongly electrified by cooling to the temperature of liquid air, which phenomenon is a pyroelectric one, the opposite ends of a crystal being respectively positively and negatively charged. In the case of tourmaline the ends have charges of the same sign on cooling as on warming, but in the case of tartaric acid the charges produced by cooling are of opposite sign to those produced by warming.

S. G. S.

2258. ***Electric Conductivity of the Air, and Meteorological Factors.*** **A. Gockel.** (Phys. Zeitschr. 5. pp. 257–259, May 15, 1904.)—As the dispersion of electricity is much less rapid in winter than in summer, while it decreases with increasing relative humidity, a direct temperature influence on the dispersion appears probable. Observations by the author at Adelboden (Alps, 1,350 m.) and by Saake [see Abstract No. 835 (1904)] seem to suggest it, but experiments in closed spaces—apt to be misleading—by H. Mache and by the author do not support it. Uhrig's experiments show an increase in the ionisation of the air with rising temperature, however, and the same ionisation was found, with the same temperature, at Adelboden (sky serene) and at Freiburg (Switzerland, misty weather). According to Richarz and Schenck the decomposition of the ozone, which is hastened by heat, gives oxygen ions, and de Thierry has shown that the ionisation of the air varies as the ozone percentage. The author has formerly held the evening and night mists and hazes responsible for the low dispersion of those hours; the same dispersion was found at Adelboden, however, in the absence of mists. The potential difference rises suddenly before sunrise; there is no corresponding phenomenon about sunset. The diurnal curve for q is similar to the barometer curve; reference is made to H. Zölss. **H. B.**

2259. *Radio-activity of the Soil and Ionisation of the Atmosphere.* **J. Elster** and **H. Geitel.** (Terrestrial Magnetism, 9. pp. 49–61, June, 1904.)—The increase of conductivity, produced in a confined volume of air by radium emanation is also observed in cellars, caves, &c., in the absence of special sources of radiation. Air withdrawn by the authors from their garden soil at a depth of 1 m. conducted 40 times better than ordinary air. The radium emanation confers radio-activity especially on negatively-charged bodies, and a wire several m. in length, charged to —2,000 volts, distinctly ionised the air of a vessel of 30 litres capacity. The water from many springs, particularly those coming from great depths, has been shown to be radio-active. The authors found the carbonic acid exhalations from the ground and the fango mud from the hot springs at Battaglio, Italy, active; their clay soil has, in the air-dried condition, remained active for 1½ years. At low pressures the radio-active air would escape from the soil, at high barometers it would be forced into it; by ionic absorption the earth would become negatively electrified, and the air positively. This would, according to Simpson and Ebert, at any rate occur when ions move from a field of higher to one of lower concentration. The disturbances of the normal field of the earth in times of barometric depressions and heavy precipitates could also be explained on these grounds. Above the sea the ionisation should be more constant. From the rate of decrease of the activity the authors are inclined to believe that the activity of the soil is due to a wide distribution of radium rather than to a universal activity of matter, and that radium emanations from the soil are, in any case, one of the causes of the ionisation of the atmosphere. **H. B.**

DISCHARGE AND OSCILLATIONS.

2260. *The Emanation from Phosphorus.* **A. Gockel.** (Phys. Zeitschr. 4. pp. 602–604, Aug. 15, 1903.)—The conductivity of air in which phosphorus had been oxidised was determined (by Elster and Geitel's discharge method) before and after passing through certain liquids, viz., distilled water, turpentine, sulphuric acid, solutions of potassium permanganate, pyrogallic acid, potassium iodide, and caustic potash. The conductivity was found to be diminished but not destroyed by these liquids, as also by heating with a Bunsen burner. It is not the removal of oxygen which explains the diminution of conductivity, as pyrogallic acid was not more potent in this way than substances indifferent to oxygen, nor is the result to be ascribed to the removal of ozone, as potassium iodide has no specially marked power over the other solutions in reducing the conductivity. In the author's opinion the properties of the phosphorus emanation depend in some unknown way on the existence of solid particles which play the same *rôle* as the carbon particles in a Bunsen flame. No evidence could be obtained of the existence of a radio-active emanation in phosphorised air. D. H. J.

2261. *Conduction in Flames.* **G. Moreau.** (Annal. Chim. Phys. 30. pp. 5–42, Sept., 1903.)—A review of the subject, with especial reference to the author's own work. The final conclusions may be given; the experimental results have already appeared in previous Abstracts. They are as follows: (1) The conduction in a flame containing saline vapours is due to a radiation coming from the corpuscular dissociation of the metal in contact with an incandescent electrode. (2) This radiation ionises the vapour in the body of the flame. The negative ions move more rapidly than the positive; the former depend only on the metal, the latter come from the remainder of the salt molecule. (3) The conduction in a pure flame arises from a similar mechanism; hydrogen furnishes the corpuscles. (4) The Hall effect is due to the electromagnetic action on moving ions. [See also Abstract No. 731 (1903).] R. S. W.

2262. *Influence of Röntgen Rays on Heat Conduction of Gases.* **K. Hahn.** (Ann. d. Physik, 12. 2. pp. 442–443, Aug., 1903. Physikal. Instit. Giessen, June, 1903.)—Two equal platinum spirals are placed each in a similar wooden vessel and heated by the same current. The resistances can be measured to $\frac{1}{10000}$ part by a differential galvanometer. The spirals are now placed at unequal distances from a Röntgen tube, but on the passage of the rays no change in resistance is found. Hence the heat conduction of the gas is unaltered. R. S. W.

2263. *Sparking Potential in Chlorine, Bromine, and Helium.* **F. Ritter.** (Ann. d. Physik, 14. 1. pp. 118–128, May, 1904. Phys. Instit. Berlin, Feb., 1904.)—According to Orgler the sparking potential can be divided into two parts—$B = b + \beta$, where b is the tension required to break through the layer of gas and β that required to overcome a surface resistance at the electrode. The ratio b_2/b_1, where b_1 refers to air and b_2 to another gas, measures what the author calls the electrical strength of the gas compared with air. This ratio for chlorine is 1·78, for bromine 1·98, for helium no definite value is found. The delay in the passage of the discharge, noticed in the first instance by Warburg, is less for helium than for air, but greater for chlorine and still greater for bromine. R. S. W.

2264. *Simple Method of Showing Penetrating Power of Radium Rays.* **T. P. Black.** (Electrician, 51. p. 732, Aug. 21, 1903.) Experiments are described which show the effect of radium rays on a spark-gap, and the penetration through lead. The discharge of two Leyden jars connected to a Wimshurst machine was able to take place through either of two exactly similar spark-gaps, the discharge taking place indifferently at each normally, but being facilitated at whichever gap was exposed to the radium. The tabulated results for first the one (1 mm. long) and then the other gap exposed to 1 centi-gm. of radium bromide, show that the effect of the radium was noticeable even through 8·5 cm. of lead. L. H. W.

2265. *Demonstration of Form of Current Curve.* **E. Gehrcke.** (Deutsch. Phys. Gesell., Verh. 6. 9. pp. 176–178, May 15, 1904. Physikal. Techn.

Reichsanstalt, Charlottenburg, April, 1904.)—H. A. Wilson has shown that the negative glow covers an area of the kathode which is proportional to the current, provided the whole of the electrode is not active. If, therefore, the length of the wire electrode occupied by the glow is measured at different phases of the discharge caused by an alternating current, the current form can be deduced. Two long wire electrodes are fused into the ends of a wide tube, so that one is near the left and the other the right side, and so that their free ends are in the same horizontal plane when the tube is in an upright position. The gas pressure is reduced to admit of the discharge passing, and the tube is placed before a revolving mirror so that the images of the electrodes form a straight line. The wave-form is then seen in the mirror, the differently coloured speck of positive light showing the zero line. As thus used, however, the complete wave is not seen, for below a certain voltage the discharge does not pass. It is suggested that the alternating current be imposed on a direct one to overcome this difficulty. Among other interesting results a curve for an induction coil is given. R. S. W.

2266. *Condensation Method of Demonstrating the Ionisation of Air.* **C. T. R. Wilson.** (Phil. Mag. 7. pp. 681–690, June, 1904.)—In former experiments it was found that the number of drops produced by expansions in air exposed to Röntgen rays was reduced in a striking manner when a sufficiently strong electric field was maintained across the air before expansion; thus the nuclei are electrically charged. Similar experiments made in the absence of ionising agents failed to show any diminution of the number of drops by the action of even very strong fields. These latter experiments have now been repeated, using larger apparatus, and with the much larger volume of air in the apparatus described in the paper, the effect of an electric field in removing the nuclei which gave rise to the rain-like condensation is found to be very striking. J. J. S.

2267. *Continuous Registration of Ionisation.* **C. Nordmann.** (Comptes Rendus, 138. pp. 1418–1420, June 6; and pp. 1596–1599, June 20, 1904.)—The object is to provide a means of obtaining a continuous record of the state of ionisation of a gas, especially air for meteorological purposes. The gas to be studied is found between the plates of a condenser, of which one plate a is raised to a potential great enough to produce the saturation current; the other plate b is joined to an electrometer, and also, through a high resistance R, to earth. If Q is the amount of electricity received by b each second, C its capacity, and E its potential, at the end of time t we have $CE = Qt - \int E/R$. Whence $E = QR(1 - e^{-t/CR})$. The exponential part can be made small, so that at the end of a very short time $E = QR$. If R be known and E recorded photographically, Q is known at any instant. In the second paper a modification of the method is described. R. S. W.

2268. *Zero Method of Measuring the Velocity of Gaseous Ions.* **E. Bloch.** (Comptes Rendus, 138. pp. 1492–1494, June 13, 1904.)—This is an improvement of the method used by McClelland and Zeleny. The ionised gas is sent along a tube in which are placed along the axis two electrodes, A and B. These are of the same diameter, but B is the longer. If the potential of these electrodes is zero, and if to the outer tube C a series of increasing voltages is applied, the potential of B will at first rise more rapidly than that of A. For a critical value V of the voltage the rate of increase in potential is the same for both; this point can easily be found by connecting them to adjacent pairs of quadrants of an electrometer. The velocity of the ions is then given by the formula $K = \frac{U}{2\pi l V} \cdot \log \frac{b}{a} \cdot \frac{C_1}{C_1 + C_2}$ [calculation not given], where U = volume of gas passing each second, l = length of electrode A, a and b are the radii of the electrodes and of the exterior tube, C_1 and C_2 are the capacities of each of the electrodes with their connections. R. S. W.

2269. *Electrostatic Deviation of Magneto-kathodic Rays.* **C. Fortin.** (Comptes Rendus, 138. pp. 1594–1596, June 20, 1904.)—By consideration of the forces acting on a negative ion of mass m and charge $-e$, placed in a magnetic field H and a perpendicular electric field F, it is shown that the rays behave to an electric field as would ordinary kathode rays travelling round the lines of magnetic force in a helix of very small radius. The electric field causes a translation of the axis of the helix parallel to the field of $-mF/H^2c$, and a rotation θ in a plane perpendicular to it, where $\tan\theta = F/Hw$ (w = original velocity of the ion parallel to the lines of magnetic force). This rotation agrees with the observations of Villard. [See next Abstract.] R. S. W.

2270. *Kathode Rays and Magneto-kathode Rays.* **P. Villard.** (Comptes Rendus, 138. pp. 1408–1411, June 6, 1904.) **H. Pellat.** (Comptes Rendus, 138. pp. 1593–1594, June 20, 1904.)—A. Broca has shown that if the kathode be placed in a powerful magnetic field, in addition to the ordinary kathode rays, which go in helices round the lines of force according to known laws, there is produced a second species which follow the lines of force. [See Abstract No. 1152 (1898).] This second class Villard calls magneto-kathode rays. Their presence is best seen in a tube filled with pure oxygen placed in a uniform, or, better, convergent field. By placing in the tube a collecting cylinder, after the method employed by Perrin for kathode rays, the magneto-kathode rays may be directed into it. The striking result is then found that the rays carry no charge. If they are acted upon by an electric field, they are deviated *perpendicularly* to the lines of electric force. The sense of the deviation changes with the direction of the magnetic and of the electric field. They are thus a kind of inverse to ordinary kathode rays. Villard supposes that Pellat has attempted to explain these phenomena by his idea of a magneto-friction. Pellat, however, denies this, and thinks that they belong to a different class altogether. R. S. W.

2271. *Duration of Phenomenon of Coherence.* **G. Tissot.** (Écl. Électr. 38. pp. 361–362, March 5, 1904. Abstract of paper read at the Congrès d'Angers of the French Assoc. for Advancement of Science.)—The author has investigated the phenomenon of coherence as regards the action of the first wave only, to ascertain whether such action is instantaneous or progressive. The coherer was placed in circuit with a source of small e.m.f. and a non-inductive resistance ρ joined to the armatures of a condenser. The coherer being decohered, a small current i_0 flows through ρ, and the condenser is charged thereby to a potential i_0. At a time t a break spark is produced near the coherer, capable of producing coherence, and coherence commences at such instant t. After a very short interval of time θ, the terminals of ρ are disconnected from the condenser which is charged to a p.d. ρi, where i is the value of the current at time $t + \theta$. To obtain i, the condenser is discharged through a ballistic galvanometer, the successive operations being performed by means of a Bouty pendulum interrupter, t being capable of being varied by a micrometer screw-adjustment of the contacts; by this adjustment it is possible to pass from a point where no coherence is produced at all to points where the resistance fall is complete; the fall does not appear to be progressive. It is not possible to give θ accurately for values between zero and $\frac{1}{4000}$ sec., but the resistance fall certainly takes place in less than this latter value. Still smaller time intervals were obtained by causing a pistol bullet to produce the spark and the disconnection. The complete resistance fall occurred even when the two wires were placed 2 cm. apart, which, allowing 200 m. per sec. for the velocity of the bullet, corresponds to an interval of $\frac{1}{10000}$ sec. [The velocity assumed seems low.] L. H. W.

2272. *Passage of High-frequency Currents through Coils.* **M. Wien.** (Ann. d. Physik, 14. 1. pp. 1–21, May, 1904. Physikal. Institut d. techn. Hochschule, Aachen, Feb. 10, 1904.)—F. Dolezalek in measuring inductances observed that with frequencies of over 800 per sec. the resistances were much greater and the inductance slightly less than the values for direct currents or slower alternations. The increase of the resistance is very much greater and follows a different law from that due to the skin effect in straight wires calculated by Rayleigh and Stefan. The present investigation is chiefly mathematical; a number of formulæ are developed for coils of various shapes and proportions. [See Abstract No. 488B (1904.) E. H. B.

2273. *Resonance Experiments on the Behaviour of a Simple Coherer.* **F. Hodson.** (Ann. d. Physik, 14. 5. pp. 973–994, Aug. 23, 1904. Extract from Giessener Dissertation.)—Kiebitz showed that a multiple-contact coherer behaved like a very large capacity or as a good conductor, as far as its influence on the natural period of the system was concerned [see Abstract No. 1929 (1901)]. Robinson, on the other hand, with single-point coherers calculated that the "apparent" capacity of the coherer was roughly 40 cm. [See Abstract No. 1135 (1904).] The author describes experiments made to settle this point and to determine what proportion of Robinson's value can be attributed to electrostatic capacity and what to the conductor, and how the coherer behaves in the case of long waves such as are used in wireless telegraphy. The experiments were made by Drude's method [see Abstract No. 839 (1903)], and the first were with nearly closed systems, the arrangements being fully described and the results given mostly in tabular form, the coherer used being first a single-point one exactly like Robinson's, and later on one with six steel balls. A single thermo-element was used for the coherer circuit, giving 0·04–0·06 volt, since Robinson had shown that coherence began at 0·4 volt. The results are summarised by the author, the following being the chief points: (1) A single-point coherer of original resistance 1,000 ohms, or less, and whose final resistance is of the order 1 ohm, behaves for waves of over 40 m., as a conductor or infinitely great capacity. (2) When the final resistance is 10–15 ohms the coherer has a finite capacity; for waves 40–70 m. long, the length of the single wire is 70 cm. longer than $\lambda/4$. (3) The "apparent" capacity is therefore 500 cm. and 1,500 cm. for waves of 40 and 70 m. respectively. (4) This apparent value indicates an electrostatic capacity (obtained by the Kirchoff equation in the form given by Robinson) of 70 to 170 cm. with a mean resistance of the coherer of 100 ohms. (5) A series of contacts behaves as a conductor for a final resistance value of 1 ohm per contact. (6) The resonance is much inferior with high final resistances. (7) With the coherer at one free end of the wire no resonance could be observed with waves of either 10–20 or 20–40 m. (8) Resonance in open coherer circuits is much less pronounced. (10) The half wave-length of natural oscillation of a wire 5 m. long is 4 per cent., of a 2·5-in. wire 8 per cent., greater than the length of the wire (effect of surrounding objects). L. H. W.

2274. *Periods of Electrical Vibrations Associated with Simple Circuits.* **J. A. Pollock.** With an Appendix by **J. C. Close.** (Phil. Mag. 7. pp. 635–655, June, 1904. Paper read before the Royal Society of New South Wales.)—The object of this research has been to compare the periods of electrical vibrations connected with narrow, rectangular, closed circuits with those of the oscillations associated with straight wires and with open and closed rings. The method adopted is essentially as follows: A condenser is discharged in the neighbourhood of a narrow, rectangular, closed circuit; oscillatory currents are thus set up in the rectangle, which in turn induce others in a third circuit of required shape. Observations of the amplitudes of the disturbances in the circuits are made with Rutherford's magnetic detectors, while the dimensions of the circuits are adjusted step by step till all three are in tune. The length of a circuit of any shape can thus be found which has the same period of electrical vibration as that of a given narrow rectangular closed circuit. The results of the present experiments on closed rings may be stated as follows: Take as a standard the period of the vibration associated with a narrow, rectangular, closed circuit, where the longer side of the rectangle is parallel to the direction of propagation of the waves. Then a similarly proportioned elliptical closed circuit with its major axis parallel to the same direction may be considered to have the same period if its perimeter is equal to that of the rectangle. If the ellipse now becomes nearer a circle in shape, the perimeter has to be decreased to keep the period unaltered, until in the limit, when the form becomes circular, the ratio of perimeter of the rectangle to the circumference of the circle becomes 1·11 for a circle of 800 cm. in circumference, the circle being of copper wire 0·33 cm. in diam., and the rectangle 30 cm. wide, of thin brass wire 0·04 cm. thick. E. H. B.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2275. *Measurement of Self-induction.* **R. Dongier.** (Comptes Rendus, 137. pp. 115–117, July 13, 1903.)—This is a convenient method involving two distinct measurements by means of a telephone and bridge and some source of alternating currents. Each measurement may, however, be used alone if the frequency is known. (1) The self-induction to be measured in series with a condenser is placed in the fourth arm of the bridge, and a variable resistance shunted to the terminals of the condenser. The bridge and resistance are then adjusted till silence is obtained in the telephone. If r_1 is the value of the resistance, K the capacity of the condenser, then $L = Kr_1^2/(1 + p^2K^2r_1^2)$, where $p = 2\pi \times$ frequency. (2) The condenser is now shunted across the self-induction and resistance in series, the whole forming as before the fourth arm of the bridge. Adjustment is made until silence is again attained. Then, $L = K(r_2^2 + p^2L^2)$. If the frequency in both tests is the same, p may be eliminated from the two expressions, giving the simple relation $L = Kr_1r_2$. The test may be rendered convenient by employing two slide wires, one in the ratio arms to vary the amplitudes of the currents in the two halves of the bridge, and the other forming part of the above-mentioned variable resistance for adjusting the phase relations. The author has found greater difficulty in the measurement of large coefficients of self-induction owing to the production of higher harmonics which prevent the attainment of a sharp minimum in the sound of the telephone. J. D. C.

2276. *Weston or Cadmium Cell.* **H. S. Carhart.** (Amer. Inst. Elect. Engin., Trans. 21. pp. 525–530, May, 1904.)—This paper is the preliminary report of the committee appointed by the A.I.E.E. to investigate the preparation of materials and construction of the cadmium cell, and it mainly consists of a detailed specification of the methods they recommend. It has previously been established that the most serious variations in the e.m.f. of such cells may be traced to the influence of the mercurous sulphate, and the chief innovation of the specification is an electrolytic method for the production of this salt so as to render it impossible for traces of nitrate to be present. A new electrolytic method for preparing the cadmium amalgam, and one for washing the mercurous sulphate without the use of pure water, are also described. The committee is satisfied that the principal difficulties in making Weston cells have now been removed, and cells made in accordance with their specification show remarkable agreement and constancy. A specimen curve is given. E. J. W.

2277. *Electrical Conductivity of Solutions in Bromine.* **W. A. Plotnikow.** (Jurn. Russk. Fisik Chimičesk. Obščestva, 35. pp. 794–810, 1903. Zeitschr. Phys. Chem. 48. pp. 220–236, May 27, 1904.)—Dissolved in bromine, $AlBr_3$, S_2Br_2, $AsBr_3$, and $SnBr_4$ do not conduct the electric current, while $SbBr_3$ is a bad conductor; the compounds $AlBr_7$, CS_2 and $AlBr_5$, C_2H_5Br, CS_2, conduct moderately well, while the concentrated solutions of phosphorus pentabromide possess conductivities of the same order of magnitude as concentrated aqueous solutions of typical salts. The specific conductivity of antimony tribromide increases continuously with the concentration, but that of concentrated solutions of complex compounds increases only very slightly. The molecular conductivity of PBr_5 in bromide reaches a maximum corresponding with the formula PBr_{25}. In course of time the conductivity changes in the case of $SbBr_3$, but remains constant for all the other compounds mentioned. The specific conductivity of the concentrated solutions in bromine is abnormally great (several thousand times greater) compared with that of the dilute solutions. From a certain concentration the conductivity becomes variable and often changes merely by shaking the resistance-vessel. The very appreciable conductivity of the complex compounds of aluminium tribromide (which is itself not an electrolyte), when dissolved in bromine, is in good agreement with the author's previous hypothesis [see Abstract No. 158 (1903)], which explains the peculiar chemical behaviour of these compounds by the formation of complex ions of aluminium. Liquid bromine can thus exert considerable dissociating power on certain substances. This result is in accord with the view that the conductivity of the solution is conditioned in equal degree by the properties of the solvent and the nature of the dissolved substance. T. H. P.

2278. *Determining Small Self-induction Coefficients by means of Singing Arcs.* **A. Petrowski.** (Collection of Physical Papers devoted to the memory of T. T. Petrouchewsky, pp. 25–85, 1904.)—Assuming that the oscillations have a sinusoidal behaviour, Janet has given for the coefficient of self-induction L of a coil connected in shunt to a singing arc, the expression $L=(v^2/i^2)C$, where v stands for the potential difference at the terminals of the coil, i for the current in the shunt-circuit, and C for the capacity of the condenser inserted in the latter. The problem dealt with by the author consisted in determining the conditions under which Janet's formula is true. The figures obtained for each of the various coils on the secondary conditions of the experiment being altered, agree very well with one another, while differing noticeably from the values calculated according to the dimensions of the coil. The method should accordingly be used only for comparative measurements, the oscillations being apparently more complicated than had been assumed. A. G.

2279. *Measuring the Coefficient of Self-induction.* **N. Boulgakoff** and **N. Smirnoff.** (Collection of Physical Papers devoted to the memory of T. T. Petrouchewsky, pp. 73–85, 1904.)—The sudden increase in the resistance after the breaking of the current by means of a mercury interrupter, affords a means of measuring the coefficient of self-induction. The current from an accumulator connected in shunt is made to pass through two branches, one containing a resistance and the other an interrupter, a standard of self-induction and a shunt galvanometer arranged in series; a commutator enabled the standard to be replaced by a non-inductive conductor of the same resistance. The stationary deflection of the galvanometer was found to be smaller when the standard was substituted for the non-inductive resistance, in virtue of the extra-currents at make; this explication is borne out by numerical calculations, allowing for the sensitiveness of the galvanometer. The extra-currents produced on rupture are of no effect because of the great resistance of the interrupter at the instant of break. The opposite takes place when the interrupter is inserted in the galvanometer shunt, on account of the fact that the whole of the extra-current attending the break traverses in this case the galvanometer, while the one produced at make is weakened by the shunt. Greater deflections are obtained through the action of extra-currents if the standard be inserted in the shunt, when, however, calculation becomes more complicated. The self-induction of the galvanometer is determined as follows: The current passing through the galvanometer and its shunt, the interrupter is inserted successively into the galvanometer branch and the main branch. The deflection observed in the first case is greater than in the second, the difference enabling the self-induction coefficient to be calculated. A. G.

2280. *The Peculiar Behaviour of some Resistance Standards.* **F. A. Wolff, Jr.** (Phys. Rev. 18. p. 457, June, 1904. Abstract of paper read before Amer. Physical Society, April 22, 1904.) — Referring to the polarisation effects noticed by Mendenhall and B. F. Thomas with some paraffin-insulated resistance coils, the author points out that the same behaviour is noticed sometimes even with shellac-insulated coils, and he attributes this to an electrolytic shunt, the polarisation of which causes an apparent increase in resistance as the test current is left on, and an apparently too low resistance on reversal of the current. The same effect is produced by dipping a coil which does not show the effect into water, and is eliminated by subsequent baking. Another effect, not previously described, manifests itself by a decrease in resistance as the current is left on, the amount depending on the applied voltage. The variation is irreversible, and probably consists of a coherer shunt to a portion of the coil due to a metal filing embedded in the shellac. Branly has already shown that such coherer effects can be obtained with solid dielectrics even. L. H. W.

2281. *On the Schloemilch Wave-detector.* **M. Dieckmann.** (Phys. Zeitschr. 5. pp. 529–531, Aug. 15, 1904.)—The author, referring to the results obtained by Reich [see Abstract No. 1756 (1904)], describes experiments of his own, which confirm the opinion which Reich has expressed, that the working is due to polarisation and is not thermal. The author employs a cell without a polarising battery, as Schloemilch had shown [see Abstract No. 211B (1904)] could be done, a 0·15 mm. copper wire fused into glass (surface 0·056 sq. mm.) being used as positive in a test-tube containing in the lower part concentrated copper sulphate solution, and in the upper part common salt solution; a zinc strip was the negative electrode. The cell was placed in series with 1,590 ohms and a mirror galvanometer. The polarisation current was 0·0000022 amp., but on a small coil connected being worked the current rose to 0·00048 amp. With the copper wire in the lower solution, although no polarisation was practically possible, the current was 0·000618 amp. without the coil working, and it sank to 0·0004 amp. with the coil going; an anticoherer action was therefore produced. Next, to test the theory that the working is due to change of resistance, a Pt–Pt cell with sulphuric acid and a polarising battery was used, and an expression is derived which enables the characteristic curves to be drawn, and from the galvanometer deflection to determine the relative value of the stimulation (excitation). The curves shown in Fig. 1 are thus obtained for values of the polarising battery p.d. of 4, 6, 8, and 10 volts; I., II., III., and IV. being the limiting values towards which the curves tend with powerful excitation ($\mathcal{J}'$ = current after excitation). The curves are for equal excitation, and show good agreement in the relative values. Since the sensitiveness varies with the polarising p.d., an expression

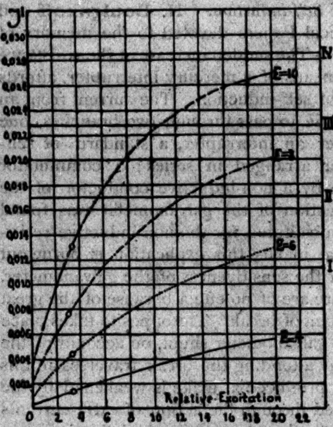


FIG. 1.

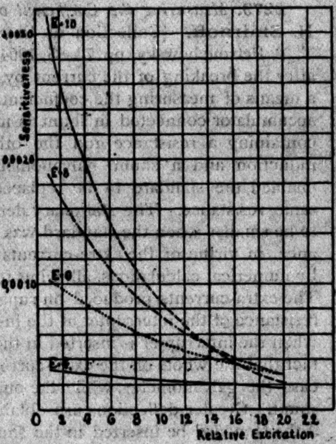


FIG. 2.

for the sensitiveness is next obtained, and the curves in Fig. 2 constructed therefrom. These show that for the weakest relative excitation a high polarising voltage is advantageous; for much stronger excitation a lower voltage is better. L. H. W.

2282. *Method of Measuring Inductance.* **Iliovici.** (Comptes Rendus, 138. pp. 1411–1413, June 6, 1904.)—r_1, r_2, r_3, and r_4 being four arms of a Wheatstone's net, the source of current being applied at the junctions of r_1 and r_2, r_3 and r_4, the coil whose inductance is to be measured is included in the arm r_1. A condenser is connected between the r_3r_4 junction, and a movable point on r_2, the position being found by trial, such that at every instant there is zero current in the galvanometer circuit. The author shows that this is the case, when, in addition to the relation $r_1r_4 - r_2r_3 = 0$, we have $L = Cr_3x\left(1 + \frac{y}{r_4}\right)$, where $x + y = r_2$. Any form of galvanometer, ballistic or otherwise, may be used, and the sensitiveness of the arrangement is much increased by using an Ayrton and Perry secohmmeter. The sensibility is also increased owing to the fact that the circuit containing self-induction may carry a large current, which is not the case in the original method of Pirani, where the current is limited by the magnitude of the capacity. S. G. S.

2283. *Changes in Thermoelectric Power with Magnetisation.* **S. Bidwell.** (Roy. Soc., Proc. 73. pp. 413–434, June 22, 1904.)—The author discusses the much-debated point whether or not magnetisation of a material sets up a mechanical compression along the lines of force. He concludes that such a compression does exist, and is purely mechanical and quite independent of the "Maxwell's stress," if any, which exists. The experimental work of the present paper shows how the thermoelectric power of couples of iron-copper, nickel-copper, and cobalt-copper is influenced by variation in magnetic field. The curves connecting these variables have no resemblance to the curves showing the strain effect of magnetisation, but if to the latter be added the ordinates for the mechanical compression, $\frac{B^2}{8\pi . M}$, a curve is obtained which coincides practically with that for the thermoelectric power. This interesting result is found for iron and nickel, but as to cobalt this coincidence, if it exists, is masked by some cause which has yet to be discovered. As further confirmation of the results, it is found that when the specimen is under considerable stress, the above coincidence still recurs. Thus there is strong evidence in favour of the mechanical compression theory. P. E. S.

ALTERNATING CURRENTS AND MAGNETISM.

2284. *Magnetisation and Magnetostriction of Nickel Steels.* **H. Nagaoka** and **K. Honda.** (Soc. Franç. Phys., Séances, 1. pp. 57–65, 1904. Journ. de Physique, 3. pp. 613–621, Aug., 1904.)—A considerable amount of research has now been done on this subject, and is here summarised. It is found that when the proportion of nickel is 29 per cent. a sudden change occurs in several properties. (1) The resistance to rupture is least whilst the elongation under stress is greatest; (2) the magnetic transformation temperature is lowest; (3) the alloy is at this point reversible and irreversible in different specimens; (4) the change of coefficient of thermal expansion is greatest; (5) probably the incomplete experiments in thermal and electric conductivity show a sharp change at the point. In explaining the unique behaviour of these alloys the above facts must be considered. **C. E. Guillaume** points out that a change of ½ per cent. in the composition or a small want of homogeneity in the specimens would quite destroy the coincidences mentioned above. He suggests that the specimens used should be carefully analysed and examined before we allow ourselves to consider that the above facts have been established. [See also Abstract No. 167 (1904)]. P. E. S.

2285. *Influence of Torsion on Circularly and Longitudinally Magnetised Iron and Nickel.* **H. Gerdien.** (Ann. d. Physik, 14. 1. pp. 51–86, May, 1904. Extract of Göttingen Inaugural Dissertation.)—A cyclic variation in torsion produces a cyclic variation in the longitudinal magnetic moment. The moment increases with a left-handed torsion in nickel and with a right-handed torsion in iron. For nickel if the total torsion is small the moment is greater on the return curve when torsion is reversed, but when the total torsion is large the moment is less on the return curve. The transition from one condition to the other is clearly shown by curves. For iron the tendency is the same, but in less degree. P. E. S.

2286. *Effect of Pressure on Magnetic Induction.* **F. C. Frisbie.** (Phys. Rev. 18. pp. 432–448, June, 1904.)—Rings of iron are used. They are placed in a box of iron having walls 2 in. thick. Resin oil is forced in and pressure applied to the inside by a screw plunger, the pressure obtainable being 18,000 lbs. per sq. in. Using a steady field it is found that increase of pressure up to 16,000 lbs. per sq. in. increases the magnetic induction by from 0·5 to 3·0 per cent., according to the primary field used. But using steady pressure it is found, in general, that for an unannealed specimen, increase of field first decreases induction to 1 per cent. and then increases it until it becomes about 1 per cent. total increase. When the specimen is annealed there is the same initial decrease but less pronounced subsequent increase. Besides the above results it is found that hydrostatic pressure alters the amount of residual magnetism. The results tend to support Kirchoff's theory for annealed soft iron. P. E. S.

REFERENCES.

2287. *Polarity of the Electric Dispersion during Thunderstorms.* **H. Mache.** (Phys. Zeitschr. 4. pp. 587–588, Aug. 1, 1903. II. Physik. Instit. der k. k. Universität, Wien.)—For the rapid observation of the excess of one kind of ions over the other, the author has constructed the following apparatus. In the middle of a wire cage of 12 cub. m. capacity, is suspended a radium electrode from which an insulated wire, 3 m. in length, is carried through an iron pipe to a quadrant electrometer; the cage and pipe are earthed. The potential within the cage rarely amounts to more than 1 volt except during thunderstorms. In order to determine the air potential, another radium electrode is fixed 2 m. above the cage and connected to an electroscope. The two potentials frequently differ widely as to intensity and to polarity. While a thunderstorm was receding, the quadrant electrometer marked from + 1 to + 24 volts, keeping fairly steady with only one excursion into the negative, while the electroscope rose from — 800 to — 40 and then + 30 volts, with one positive value of + 40 volts. The author confirms Pochettino's observation of a pronounced polarity in the free ions of the air during thunderstorms. H. B.

2288. *On Recent Researches in Electrostriction.* **M. Cantone.** (N. Cimento, 7. pp. 126–137, Feb., 1904. From Rendiconti del R. Ist. Lomb. di. Sc., vol. 37, 1904.) —The author here refers to papers written by himself and F. Sozzani [see Abstract No. 633 (1901)] criticising More's work on the same subject (Rendic. R. Accad. Lincei, 4. p. 344, 1888). In the present paper he discusses the experiments of Shearer [see Abstract No. 700 (1902)], and further, a recent work (Phil. Mag. 6. p. 1, 1903) written by More in answer to criticisms on his paper of 1900 on a supposed elongation of the dielectric. He also discusses the work of M. Wien and Wüllner. The paper cannot be profitably studied except by comparison with the earlier works referred to. [See also Abstract No. 1148 (1904).] S. H. B.

2289. *Atmospheric Electricity near the Sea-shore.* **A. Löwy** and **F. Müller.** (Phys. Zeitschr. 5. pp. 290–294, June 1, 1904.)—Last August and September the authors took observations, with Elster and Geitel apparatus, on the islands of Heligoland and Sylt, both on the dunes, about 40 m. above sea-level and 50 m. from the shore, and on the sea-shore. The dispersion of positive electricity was slow on the dunes; on the sea-shore the mean dispersion values were low, as is generally the case. A possible connection between the ionisation of the air and the physiological effects of mountain and sea air is suggested, and references are made to Elster and Geitel [see Abstracts No. 1706 (1902) and 914 (1903)] and to Saake [see Abstract No. 835 (1904)]. H. B.

2290. *Recording Electrometers for Atmospheric Electricity.* **A. Sprung.** (Phys. Zeitschr. 5. pp. 326–329, June 15, 1904.)—In order to increase the range of the Benndorf electrometer, which has been installed at the Potsdam Observatory, the author has combined it with a mercury switch which automatically cuts out 80 of the 100 calomel cells, as soon as the needle reaches the edge of the tape under the influence of a potential difference of about 700 volts per metre. The amplitude of the potential curve is thereby reduced to one-fifth; a reduction to one-third would certainly be safe. Other means for enlarging the range are mentioned. The author has also devised another form of recording electrometer, suitable for Ebert's absorption apparatus; an insulated point of platinum is attached to the needle for the purpose of renewing the electric charge when a certain loss by dispersion has occurred. He was unaware that a similar instrument was described by L. Kann in 1901. H. B.

2291. *Preparation of Argon by means of Electric Sparks.* **A. Becker.** (Zeitschr. Elektrochem. 9. pp. 600–602, July 23, 1903.)—In the isolation of argon by passing electric sparks through air, it is found that the conversion of the nitrogen and oxygen of the air into nitrogen oxides proceeds the better, the narrower the space in which the gases are subjected to the spark and the greater the length of the spark, to which the quantity of oxides formed is approximately proportional. The velocity of the gaseous stream must be exactly suited to the dimensions of the apparatus, so that but little uncombined nitrogen can pass the spark and no decomposition of the oxides take place. The absorption of the nitrogen oxides must be complete. An apparatus is described which is capable of treating 4 litres of a mixture of equal volumes of air and oxygen per hour. T. H. P.

2292. *Oscillatory Point Discharge at Low Pressures.* **K. Przibram.** (Phys. Zeitschr. 4. pp. 581–583, Aug. 1, 1903.)—For the further elucidation of the Himstedt effect [see Abstract No. 1708 (1899)], viz., that a conductor placed near a point connected to a Tesla transformer is charged positively or negatively according to its distance from the point, the effect is tried of varying the pressure. Outside the sparking length the critical distance, or distance at which the conductor is neutral, is found to be nearly proportional to the pressure. Increase of pressure causes negative electrification of the conductor, decrease positive electrification. The pressures at which the conductor was neutral at distances 10 and 15 mm. were 480 mm. and 590 mm. respectively. An induction coil was employed in producing the oscillations. [See also Abstracts Nos. 84 (1903) and 1775 (1904).] G. E. A.

2293. *The Electric Arc.* **J. Stark.** (Ann. d. Physik, 12. 4. pp. 673–713, Oct., 1903.)—This paper examines the properties and functions of the ions in the electric arc, and some of its peculiarities are explained from this point of view. It also contains experimental results which the author has obtained with a view to the examination of his theoretical hypothesis. W. H. S.

2294. *Phase of Electrical Vibrations.* **G. Seibt.** (Phys. Zeitschr. 4. pp. 817–820, Nov. 1, 1903.)—The theory of forced vibrations shows that the phase relation between oscillator and resonator may be expressed by the angle 0° or 180°, according to which has the greater period. An arrangement to illustrate this experimentally is described, in which by the addition of a piece of tinfoil to one of the coils in question the phase angle changes from 0° to 180°, as shown by a spark leaping across a gap. E. H. B.

2295. *Resonance of Electrical Oscillations.* **K. E. F. Schmidt.** (Ann. d. Physik, 14. 1. pp. 22–50, May, 1904.)—Having used Tesla vibrations for the study of optical phenomena, the author wished to find how the greatest energy could be concentrated into a given space, *e.g.*, a vacuum tube. The present paper deals with experiments on a Tesla apparatus undertaken with this purpose. It contains full details of the installation adopted, and a number of figures and tables illustrating the effects of the various factors on the result. E. H. B.

2296. *Theory of Braun's Transmitter.* **L. Mandelstam.** (Phys. Zeitschr. 5. pp. 245–248, May 1, 1904. Physik. Institut d. Univ., Strassburg, Feb. 4, 1904.)—A discussion of the views on this transmitter held by Seibt, Wien, and Zenneck, with mathematical theories of the phenomena involved in the various forms adopted. [See Abstracts Nos. 1077 and 1083 (1903).] E. H. B.

2297. *Conduction in Flames.* **F. L. Tufts** and **J. Stark.** (Phys. Zeitschr. 5. pp. 248–254, May 1, 1904.)—No matter what the distance between the electrodes may be, when the potential gradient reaches a certain value the current increases faster than the voltage, so that it is impossible to reach a saturation current. The greater part of the paper is concerned with the theoretical aspects of this fact, ionisation by collision being regarded as the chief factor. [See also Abstract No. 1178 (1904).] R. S. W.

2298. *Sparking Potential.* **P. E. Shaw.** (Roy. Soc., Proc. 73. pp. 337–342, May 28, 1904.)—This is a preliminary account of experiments in which the sparking distance is a fraction of a micron. As far as they go the results show that the relation between sparking potential and length of spark is a linear one. R. S. W.

2299. *Conduction in Flames.* **E. Marx.** (Phys. Zeitschr. 5. pp. 298–300, June 1, 1904. Physikal. Institut d. Univ., Leipzig.)—The paper is a reply to J. Stark, who joined in the discussion between the author and H. Starke. [See Abstract No. 395 (1904).] The author reviews the work of several experimenters with particular reference to the three questions: (1) Are the negative carriers electrons, or ions of an electrolytic character? (2) Is the dissociation in the flame principally a volume or a surface dissociation? And (3) is Poisson's equation applicable? The author does not describe any new experimental work. S. G. S.

2300. *Electrification of Recently-prepared Gases.* **E. Bloch.** (Comptes Rendus, 138. pp. 1599–1600, June 20, 1904.)—The author finds that all recently-prepared gases which conduct electricity contain, besides charged centres, a very fine solid dust or liquid spray. The velocity of the ions measured by his zero method [see Abstract No. 2268 (1904)] is about 0·01 mm. per sec. under 1 volt per cm. R. S. W.

2301. *Wave Demonstration with the Rogel Spiral.* **R. Heilbrun.** (Phys. Zeitschr. 4. pp. 567–568, Aug. 1. 1903.)—The author describes an arrangement whereby the Roget spiral can be used for showing longitudinal mechanical oscillations due to alternate attraction and repulsion of a number of springy wire spirals. The apparatus works best with the axes of the coils horizontal, but a mechanical break to produce the current impulses is then required. As long as the contact-breaker works properly each spiral oscillates in a half wave-length, with the node at the centre and loops at each end. Thus with two spirals one wave-length is obtained. L. H. W.

2302. *Theory of Oscillographs.* **A. Blondel.** (Écl. Électr. 36. pp. 326–346, Aug. 29, 1903.)—See Abstract No. 840 (1903).

2303. *Measurement of High Potentials.* **E. Voigt.** (Ann. d. Physik, 12. 2. pp. 385–406, Aug., 1903. Extract from Würzburger Inaugural Dissertation.)—The author claims that he can measure potentials up to 100,000 volts to 1–2 per cent. accuracy. A specially prepared rod of maple is used for a high resistance. One end of this is earthed, and the potential fall over a part of it is measured by an electrometer. Knowing the resistance of the whole, the potential difference of the ends is deduced. R. S. W.

2304. *Conductivity of Saturated Aqueous Solutions of Black and Red Mercuric Sulphide.* **R. G. van Name.** (Zeitschr. Anorg. Chem. 39. 1. pp. 108–111, March 15, 1904. Physikalisch-chemisches Institut, Leipsig, Aug., 1903.)—The conductivity measurements were affected, in the case of the black sulphide, by the presence of floating particles which are themselves conducting; the red modification has only a slight conductivity in the solid state. With a moderate approximation, the value of K at 25° is 0·01 to 0·02 × 10^{-6} for both forms. T. H. P.

2305. *Electric Osmosis in Methyl Alcohol.* **A. Baudouin.** (Comptes Rendus, 138. pp. 1165–1166, May 9, 1904.)—In the manner previously described for monovalent ions [see Abstract No. 1744 (1904)], the author has investigated the action of divalent ions on the charge of a porous partition immersed in methyl alcohol. The observations made show that positive ions have little or no influence on the positive charge of a diaphragm ($CrCl_3$), but that they diminish or reverse the electrification of a negative diaphragm (SiO_2, PbI_2, S); the reverse holds for negative ions. These phenomena are virtually the same as with aqueous solutions. T. H. P.

2306. *Specific Electrical Resistance of Non-metallic Bodies.* **P. Ferchland.** (Zeitschr. Elektrochem. 9. pp. 670–673, Aug. 13, 1903. Chem. Institut der Universität, Halle, July, 1903.)—Streintz has stated that lead peroxide is a good conductor when a compressed powder is used. [See Abstract No. 473 (1903).] The author has prepared a lead peroxide by electrolysing with a current density at the anode of 5 amps. per sq. dcm. a neutralised solution of lead nitrate. It is a hard, black substance, which when dried is pure PbO_2. A rod of the material was compressed between lead-covered copper electrodes and subjected to pressure until the resistance was a minimum. The specific resistance obtained by the bridge method was from 29·9–37 × 10^6 c.g.s. units—a result 13–16 times greater than that found by Streintz. [See also next Abstract.] W. W. H. G.

2307. *Errors in Measuring the Electrical Resistance of Lead Peroxide.* **F. Streintz.** (Zeitschr. Elektrochem. 10. pp. 414–415, June 17, 1904.)—This is a criticism of the work of P. Ferchland [see preceding Abstract]. He points out that the method of measurement involves serious errors due to contact resistances. Further, where the lead is in contact with the PbO_2 at the positive pole, a layer of oxide is formed, as shown by Dolezalek, which will introduce a high resistance. Streintz maintains that his result of 2·28 × 10^5 c.g.s. units is the upper limit of the resistance of lead peroxide. W. W. H. G.

2308. *Study of the Primary of an Induction Coil by means of the Ondograph.* **A. Broca** and **Turchini.** (Soc. Int. Élect., Bull. 4. pp. 235–240, April, 1904.)—The authors describe experiments made with two coils of 25 cm. and 55 cm. spark-length respectively, using a mercury turbine interrupter. In using the small coil the phenomena took place with such rapidity that a tracing on smoked paper had to be employed in place of the usual ink-writing pen of the ondograph. Curves are reproduced of the current and of the p.d. at the condenser terminals. With the smaller coil these show that the p.d. reaches a maximum about 1/1000 sec. after rupture of the current, and that about the same time is taken to return to zero at the instant of closing the circuit. With the larger coil analogous results were obtained, but the period of oscillation was about 1/100 sec. It was observed in this case that the p.d. at the condenser terminals gave a wavy curve of the same period as that of the p.d. at the primary terminals. The cause of these waves is unknown to the author. The condenser capacity is stated, but the self-inductions of the coils are only referred to as being small and very large respectively. L. H. W.

2309. *New Principle for Electric Clocks.* **K. Siegl.** (Zeitschr. Instrumentenk., Beib. 9. pp. 81–85, May 1, 1904. Innsbruck Inaugural Dissertation.)—The author, after dwelling on the properties of selenium and selenium cells, describes a method of driving and regulating clocks electrically by the use of selenium cells. The selenium cell, by Ruhmer, in an exhausted pear-shaped bulb, was placed in the focus of a parabolic cylindric mirror so that the light from a glow-lamp could impinge upon the cell whenever a seconds pendulum passed its lowest point, at which a slit in a card fastened on the pendulum coincided with a slit on a fixed screen. The effect on the selenium is made to actuate an electromagnet (placed just to one side of the point of highest velocity, owing to the lagging of the cell) so that an impulse is imparted to the pendulum at the right instant. Another selenium cell can be used for imparting motion to a series of other electrically operated clocks, which can be of the step-by-step type. A clock on these lines has given satisfaction and demonstrated that an electric clock without contacts can be made. Suggestions as to the types of pendulum and the merits of each are discussed. L. H. W.

2310. *Small Capacities Measured by an Adjustable Standard.* **H. Gerdien.** (Phys. Zeitschr. 5. pp. 294–296, June 1, 1904. Geophysikalisches Institut, Göttingen, Feb., 1904.)—An account of a method of measuring small electrical capacities by means of a standard adjustable capacity consisting of coaxial cylinders fitted with a sliding action actuated by a screw and read off by a fine scale. E. H. B.

2311. *The Standard Cell.* **F. A. Wolff, Jr.** (Phys. Rev. 18. pp. 454–456, June, 1904. Abstract of paper presented at the Washington meeting of the Amer. Physical Society, April 22, 1904. Amer. Electrochem. Soc., Trans. 5. pp. 49–58; Discussion, p. 58, 1904.)—The paper briefly discusses the main proposition which will be taken up by the Chamber of Delegates in the St. Louis International Electrical Congress—the redefinition of the fundamental electrical units. The probability of the Weston cell displacing the Clark cell is considered to be very great owing to the reproducibility of the former, and an electrolytic method for the preparation of the mercurous sulphate described, devised by the author, which is practically the same as that described independently by Carhart [see Abstract No. 2276 (1904)]. L. H. W.

2312. *Bolometers as Detectors of Electric Waves.* **Tissot.** (Journ. de Physique, 3. pp. 524–532, July, 1904.)—The author gives further particulars as to improvements in the bolometer previously described [see Abstract No. 375 (1904)]; he now uses wire of 20, 12, and 10 μ diam., a wire of 20 μ diam., of specially purified Pt giving a temperature variation coefficient of 3·8 per cent. The arrangements used and a number of experiments made to show the use of the instrument as a quantitative instrument are detailed. L. H. W.

2313. *Fundamental Equations of Variable Currents in Branched Circuits.* **A. Willame.** (Assoc. Ing. Él. Liége, Bull. 4. pp. 91–113, Jan.–Feb., and pp. 122–138, March, 1904.)—The author considers in detail the most convenient methods of dealing with a network containing resistances, self-inductances, and capacities, and acted on by a given impressed e.m.f. The paper is of an entirely mathematical character, and does not admit of a useful abstract. A. H.

2314. *Magneto-kinetic Researches.* **H. du Bois.** (Ann. d. Physik, 14. 2. pp. 209–235, June, 1904. Utrecht University, Feb. 23, 1904.)—The author has recently investigated theoretically the behaviour of a polarised gyroscope in a uniform field [see Abstract No. 1165 (1904)]. The present paper deals with experiments on a number of gyroscopes or tops made of nickel, tungsten steel, &c., and with the axes in various positions relatively to the direction of the field. E. H. B.

2315. *Rotation of Liquids in a Magnetic Field.* **P. Drude.** (Zeitschr. Elektrochem. 9. pp. 666–668, Aug. 13, 1903.)—The author describes further experiments [see Abstract No. 1113 (1902)] on the phenomenon noticed by Urbasch, and the following conclusions are drawn: Rotation is most marked in the diffusion of water in H_2SO_4, less marked in its diffusion in HCl, and absent in its diffusion in $CuSO_4$ solution, rotation sometimes occurring in different directions in the same vessel. The rotations are explained by thermo-currents, and are for this reason most marked in diffusion in H_2SO_4. The liquid mixture only moves when, through temperature differences or other processes, the diffusion is accompanied by an electric current. [See also Abstract No. 1801 (1904).] L. H. W.

2316. *Lunar Diurnal Variation of the Magnetic Elements Determined from One Complete Lunation.* **L. A. Bauer** and **R. E. Nyswander.** (Terrestrial Magnetism, 8. pp. 144–146, Sept., 1903. Abstract.)—A successful attempt has been made at Cheltenham to determine the lunar diurnal variations simply from the complete lunation of the magnetically calm February, 1903, photographic records being obtained with the Eschenhagen magnetograph. The observations concern declination and horizontal intensity, and will be extended. Publication of details is deferred. H. B.

2317. *The New Bamberg Magnetic Theodolite of the Pola Observatory.* **W. Kesslitz.** (Terrestrial Magnetism, 8. pp. 130–143, Sept., 1903.)—Illustrated, critical description of the theodolite constructed by C. Bamberg, of Friedenau, near Berlin, after the model of the normal theodolite of Potsdam, with improvements suggested by Eschenhagen. The parts for measuring the angles and for determining the periods are independent of one another. H. B.

2318. *Direct-recording Magnetic Variometer.* **W. G. Cady.** (Terrestrial Magnetism, 9. pp. 69–80, June, 1904.)—The instrument is to show the magnetic character of the day at a glance. A magnet, 16 cm. long, is suspended by a bundle of silk fibres; attached to it is, at right angles, a light brass arm (the magnet arm), ending in a glass rod, 0·2 mm. in thickness. The glass rod is bent upwards. A second, horizontal brass arm (the pen arm) is suspended by one twisted fibre; it carries at the one end the pen, and at the other two little glass rods, forming a horizontal fork for the glass rod. Near the end of the pen arm and under it is placed a solenoid with a curved slot, into which a little magnetic rod, pointing downward from the pen arm, is drawn when the circuit is closed, for one second once every minute, by the same clockwork which moves the paper tape on the drum under the pen. The author discusses the sensibility of his instrument, and reproduces some of the dotted curves obtained. There is some friction between the glass fork and rod, but the jar with which the pen arm flies up when released by the solenoid overcomes this friction. H B.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2319. *New Electric Resistance Furnace.* **O. Frölich.** (Zeitschr. Elektrochem. 9. pp. 628–629; Discussion, p. 629, Aug. 6, 1903. Paper read before the 10 Hauptversammlung der Deutschen Bunsen Gesell., June 3–8, at Berlin.) —The author's furnace is built up of bricks of a material which conducts the electric current in the cold state about twenty-five times less than carbon, and hot, sixteen times less; it is not attacked by direct currents of usual voltages, and the melting-point lies above 2,000° C. The furnace temperature of such a jacketed furnace can be pushed above 1,600° C. An insulating material which does not conduct the current at white heat is also mentioned; details are not given. **G. P. Drossbach** mentioned that thoria is such an insulator at white heat when quite pure; the presence of impurities, particularly of acid oxides (Ti), increases the electric conductivity considerably. **W. Nernst** added that he had had examined a large number of oxides which in the pure state were all insulators at temperatures up to 1,700° C.

H. B.

2320. *Viscosity of Aqueous Solutions of Chlorides, Bromides, and Iodides.* **W. W. Taylor** and **C. Ranken.** (Roy. Soc. Edinburgh, Proc. 25. pp. 231–241, 1903–1904.)—A comparison of the viscosities of aqueous solutions of KCl, KBr, KI, HCl, and HBr at 0°, 15°, and 25° C., and at concentrations of 1, 2, and 3 gm. molecules per litre, shows considerable differences in viscosity of chloride, bromide, and iodide, and especially in the effect of change of temperature and concentration. In every case the viscosity decreases with increase of temperature, but at different rates for the three salts, that for the chloride being greatest, and for the iodide least. The effect of concentration depends on temperature, and may affect the viscosity in opposite directions at different temperatures. The electrical conductivity of the solutions was also determined at 0° C., but the differences between the results for the three salts were very similar to those found by Kohlrausch at 18° C.

W. H. Sl.

2321. *Atomicity and Atomic Weight of Glucinum.* **S. M. Tanatar.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 82–86, 1904.)—In this preliminary communication the author gives it as his opinion that glucinum is a quadrivalent element of atomic weight 18·2, and that the compounds described by Urbain and Lacombe as of the type $Be_4O(OR)_6$ have the formula Be_2OR_6 and the constitution $R_3 \vdots Be . O . Be \vdots R_3$, for example—

$$Be(OAc)_3 . O . Be(OAc)_3.$$

The atomic weight 18·2 multiplied by the specific heat at low temperatures (0·3756–0·409) gives 6·8–7·4 for the atomic heat. Attempts to prepare alums containing glucinum and rubidium or cæsium yielded readily-soluble double salts which possess neither the composition nor the crystalline form of alums, but crystallise in the rhombic and monoclinic systems.

T. H. P.

2322. *Absorption of Oxygen by Alkaline Cerous Solutions.* **E. Baur.** (Ber. Deut. Chem. Gesell. 37. pp. 795–798, 1904.)—The absorption of oxygen by alkaline cerous solutions is greatly influenced by the degree of alkalinity and by the character of the cerium salt. Three specimens, A nitrate, B and C chloride, gave the following absorptions in percentages of peroxide salt formed : A, 55, 48, 56, 54·2, 55 ; B, 52·3, 44·2, 37·2, 51·2, 52·3, 55, 44, 52·3 ; C, 72·1, 62·1, 72·0. Specimen B, which gave about 50 per cent. absorption in presence of potassium carbonate, gave 60·1, 75·9, 67·8, 59·3, 76·3, and 62·8 per cent. when the carbonate was partially converted into hydrogen carbonate, whilst when sodium hydroxide was added to the carbonate the absorption of oxygen was scarcely greater than that required to convert the cerous into a ceric salt. T. M. L.

2323. *Atomic Volumes of Metals of the Rare Earths and their Significance for the Periodic System.* **C. Benedicks.** (Zeitschr. Anorg. Chem. 39. 1. pp. 41–48, March 15, 1904. Upsala Universitätslaboratorium, Dec., 1903.)—On the basis of the molecular volumes of the sulphates, ethyl sulphates, oxides, &c., as well as the recently determined values of some of the atomic volumes (Muthmann), the author establishes the position of the metals, praseodidymium, samarium, gadolinium, erbium, and ytterbium on the Lothar Meyer atomic volume curve, namely, approximately in a straight line between cerium and tungsten. From this position follows the homologous relationship of this group to scandium, titanium, yttrium, and zirconium. This justifies the classing together of these elements in a single group common to the third and fourth vertical series, whereby the total number of horizontal series is reduced to nine, and the number of gaps to eight. Somewhat similar suggestions have been already made by Retgers, Steele, Biltz, Brauner, Reychler, and Rudorf. F. G. D.

2324. *Optically Active Nitrogen Compounds. d- and l-Phenylbenzylmethylethylammonium Salts.* **H. O. Jones.** (Chem. Soc., Journ. 85. and 86. pp. 223–234, Feb., 1904.)—From an examination of the behaviour of various phenylbenzylmethylethylammonium salts, it is concluded that ammonium compounds of the type $NR'R''R'''R''''X$ can be resolved into enantiomorphously related optically active forms, although the resolution may often be difficult owing to the feeble rotatory power of the salts and the ease with which racemisation takes place ; the existence of optical activity is independent of the existence of ordinary isomerides of the salt. Racemisation of the active salts takes place very readily on heating or on allowing solutions in chloroform to remain in the cold ; the cause of the racemisation is probably dissociation into tertiary amine and alkyl iodide, followed rapidly by recombination, as suggested by Pope and Harvey. [See also Abstract No. 891 (1904).] T. H. P.

2325. *Stereochemistry of Carbon Compounds, especially the Unsaturated Systems.* **P. Pfeiffer.** (Zeitschr. Phys. Chem. 48. pp. 40–62, May 10, 1904. Chem. Universitätslaborat., Zürich, Oct., 1903.)—After discussing in detail the many phenomena in connection with maleinoid and fumaroid compounds which do not agree with the van't Hoff-Wislicenus theory, the author proposes a new stereochemical theory of such compounds which is particularly adapted to showing the relationship between the ethane, ethylene, and acetylene forms, and the connection between the stereoisomerism of such carbon compounds and that of complex ammonia compounds of platinum and cobalt (as described by Werner's theory). In the saturated compounds C_2a_6 or $a_3C - Ca_3$, the six groups are supposed to be grouped round the complex

C_2 of two carbon atoms in the form of an octahedron. The unsaturated ethylene form, C_2a_4, and acetylene form, C_2a_2, are derived from C_2a_6 by the removal of pairs of oppositely placed atoms, so that the C_2a_4 form receives a plane formula, the C_2a_2 form a "line" formula. In this theory the notion of constant and spatially directed valencies is dispensed with. It is shown that it is competent to describe the known facts in a simple and natural manner. It would be impossible in the space of a brief Abstract to give an adequate idea of this new theory, so that reference must be made to the original. F. G. D.

2326. *Silicide of Ruthenium.* **H. Moissan** and **W. Manchot.** (Annal. Chim. Phys. 2. pp. 285–288, June, 1904.)—When a mixture of 1·5 gm. of powder ruthenium and 7 gm. of crystallised silicon is placed in a boat of carbon within a tube also of carbon, and then electrically heated for 2–3 min. with a current of 600 amps. at 120 volts, combination with liberation of brown vapour takes place. The product is reduced to powder, then treated with soda, next with a mixture of HF and HCl. White crystals remain which are mixed with carborundum, which may be separated owing to the difference of density by the use of iodide of methylene. The same crystals may be obtained in a state of greater purity by heating by an electric furnace in a carbon crucible a mixture of 1·5 gm. of ruthenium, 1·5 gm. of silicon, and 5 gm. of copper. The reaction proceeds with regularity at the temperature of the boiling-point of copper silicide, and after the treatment just described, gives a well-crystallised silicide of ruthenium, free from carbon silicide and corresponding to the formula RuSi. The yield is 80 per cent. of the ruthenium used. The prismatic crystals of RuSi are very brilliant, are white in colour, and of metallic appearance. The density is 5·4 at 4°. It is very hard. It scratches rock crystal, topaz, and ruby. Chemically it is very stable. The action of various agents is described, and also the method of analysis.

W. W. H. G.

2327. *On Vaporised Carbon.* **Berthelot.** (Annal. Chim. Phys. 2. pp. 185–192, June, 1904.)—The deposit that is formed on the walls of a glow lamp has been examined. The deposit obtained from lamps after incandescence at a relatively low temperature was treated with HNO_3 and $KClO_3$, and after prolonged action was finally dissolved. This shows that the deposit contains neither graphite nor diamond, but is a variety of amorphous carbon. Filaments which had been submitted to incandescence for an hour were next examined. To dissolve them it was found necessary to give them a preliminary treatment with NH_4F and H_2SO_4 to remove any silicious matter. After this operation they were washed and dried, then immersed in concentrated HCl, again washed and dried. They were now reduced to an impalpable powder in an agate mortar. Finally the powder was acted upon with HCl and $KClO_3$, and heated, when the powder dissolved completely. With filaments that had been in use until they were broken the same result was obtained. The carbon of these filaments therefore was not graphitised. The note ends with a discussion on the special properties of the varieties of carbon considered as a series of polymers. [See also Abstract No. 941 (1903).]

W. W. H. G.

2328. *Significance of Changing Atomic Volume.* IV. *Effects of Chemical and Cohesive Internal Pressure.* **T. W. Richards.** (Amer. Acad., Proc. 39. 23. pp. 581–604, June, 1904; Zeitschr. Phys. Chem. 49. pp. 15–40, July 26, 1904.)—This paper gives a further discussion of the author's hypothesis of compressible atoms and molecules [see Abstract No. 673 (1903)]. It is shown that this hypothesis is capable of giving a qualitative account of the relationship between many different properties of substances, such as heat of formation, contraction resulting from chemical combination, density, compressibility, boiling-point, &c. Besides the assumption of compressible atoms—an assumption which is consistent either with the modern corpuscular theory or with the view that the atom is an ultimate continuous though compressible aggregation—the author employs in the development of his theory a relatively small number of general guiding principles, which may be briefly stated as follows: (1) Internal pressure, due both to cohesive attraction (cohesive pressure) and chemical affinity (affinity pressure), tends to diminish the volume of condensed systems (liquids and solids) by compressing the atoms. (2) The greater the pressure, the greater the resulting compression. (3) Other conditions being equal, a substance already much compressed by internal pressure suffers less contraction upon subjection to additional pressure than one but little compressed. For an application of these principles to the elucidation of many hitherto obscure relationships, and for many details concerning newly-determined and exact data, the reader must be referred to the original. F. G. D.

2329. *Revision of the Atomic Weight of Rubidium.* **E. H. Archibald.** (Chem. Soc., Journ. 85. and 86. pp. 776–790, June, 1904.)—A historical account of previous determinations of the atomic weight of rubidium is given, after which comes a description of the author's measurements on rubidium chloride and bromide very carefully purified by crystallisation. The mean number obtained, which differs but slightly from any of the individual values, is 85·485. The lower results obtained by former investigators must have been due chiefly to the presence in their material, of potassium, which is almost as difficult to remove as cæsium, whilst its detection spectroscopically gives a great deal more trouble. T. H. P.

2330. *Atomic Weight of Nitrogen by means of Nitrogen Monoxide.* **P. A. Guye** and **St. Bogdan.** (Comptes Rendus, 138. pp. 1494–1496, June 13, 1904.)—Physico-chemical methods [see Abstract No. 2035 (1904)] give results which do not agree with those of Stas. A direct method, independent of the atomic weights of other elements, has been worked out by the authors. Experiments are still in progress, but some of the results can now be given. Full details as to the apparatus and method are to be published later. The pure gas, prepared from hydroxylamine hydrochloride and sodium nitrate, is received in a small cooled tube filled with purified charcoal. After weighing this tube, it is gently heated and the gas passed over a weighed iron spiral heated to incandescence by an electric current. The best results ($O = 16$) are at present:—

Nitrous Oxide.	Oxygen.	Atomic Weight.
1·1670 gm.	0·4242 gm.	14·009
0·9498	0·3453	14·005
0·8652	0·3145	14·008
1·2247	0·4455	13·992
1·4202	0·5159	14·023

The mean, 14·007, is in close agreement with the result of the physico-chemical determinations, viz., 14·004. F. S.

2331. *A New Carbide of Molybdenum.* **H. Moissan and K. Hoffmann.** (Comptes Rendus, 138. pp. 1558–1561, June 20, 1904.)—The authors have been successful in preparing MoC. A mixture of 25 gm. of molybdenum coarsely powdered, of 25 gm. of aluminium in small fragments, and 0·2 gm. of petroleum coke is enclosed in a carbon crucible and heated in an electric furnace. A current of 500 amps. at 100 volts was used for 8 min. The crucible should be covered with a carbon disc to avoid a too great elevation of temperature, which causes the distillation of aluminium. The product is powdered and treated with an aqueous solution saturated with equal parts of NaHO and KHO. When the evolution of H ceases the action is stopped. A black crystalline powder remains, which is treated for a long period with a hot mixture of 3 of H_2SO_4 and 1 of water, then with both concentrated and dilute HCl, and finally with distilled water. The residue is dried at 100°. A mixture of graphite and a dense crystalline powder remains, which latter is separated by bromoform. The MoC is in the form of brilliant prismatic crystals with a density of 8·4, and hardness between 7 and 8. Heated to redness in a current of H, it does not change. It is with difficulty attacked by acids (excepting HNO_3), and is not decomposed by cold water or by water vapour at 600°. It is analogous to the carbide of tungsten of Williams. [See also Abstracts Nos. 940 and 1286 (1903).] W. W. H. G.

2332. *Measurement of High Osmotic Pressures.* **Berkeley and E. G. J. Hartley.** (Roy. Soc., Proc. 73. pp. 436–443, June 22, 1904.)—For the measurement of high osmotic pressures the ordinary method of Pfeffer is unsuitable, on account of the difficulty of securely attaching the manometer to the porous pot, and the authors first tried an apparatus in which the semi-permeable membrane was deposited on a porous plate tightly squeezed between two hollow spheres, in one of which was placed the solution, in the other water, but the time taken for the pressure to develop was too long. A modification of Tammann's method was finally adopted, in which pressure is applied to the solution until the osmotic pressure has been reached. The apparatus consists of a porcelain tube 15 cm. long, external diam. 2·5 cm., and internal diam. 1 cm., the membrane being formed on the whole length of the outer surface. This tube is surrounded by a brass casing containing the solution, to which the pressure is applied by a steel pressure tube. The ends of the porcelain tube are closed by pieces of thick-walled rubber tubing through which brass tubes pass, one of which is connected to a glass tap, the other to a glass capillary, graduated in mm. and calibrated. To measure the osmotic pressure, the porcelain tube is filled with water, and the pressure on the solution gradually increased till the level of the water in the capillary ceases to fall and commences to rise, the pressure at the turning-point being the osmotic pressure, corrections being necessary, however, for the "guard-ring" leak and for leakage due to the membrane not being absolutely impervious to sugar. The best membranes were obtained by depositing the film by diffusion, and then finishing it by the electrolytic method. This apparatus has been used for pressures up to 120 atmospheres, and should afford a means of determining the osmotic pressure of solutions of substances for which no truly semi-permeable membranes have yet been found. It also requires little time in working, an experiment taking 2 to 3 hours only. W. H. Si.

2333. *New Class of Ether-Oxides.* **M. Descudé.** (Comptes Rendus, 138. pp. 1703–1705, June 27, 1904.)—By treating well-cooled oxy-dimethylene chloride with small quantities at a time of sodium ethylate, a mixture of sodium chloride, diethyl formal (boiling-point 85°), and another liquid boiling at 140° is obtained. After removing the sodium chloride, this liquid is separated in the pure state by rectification, and from analysis, vapour density, and cryoscopic determinations, its formula is found to be $C_6H_{14}O_3$. It is a colourless, mobile liquid, with an ethereal odour, soluble in various organic solvents and in about ten times its weight of water, from which it separates again on addition of caustic or carbonate alkali. Its sp. gr. at 25° is 0·9078, and in chemical properties it approaches those of the formals. These and its method of preparation indicate the formula $(C_2H_5 . O . CH_2)_2 . O$, which is confirmed by the determination of its molecular refraction, and the author assigns to the compound the name dioxyethyl-dimethylene ether. By substituting sodium methylate in the reaction, dioxymethyl-dimethylene ether is produced, without the formation of any methylal. This substance in the form of vapour gives with oxygen a mixture which detonates at a red heat.

W. H. St.

2334. *Distillation of a Mixture of Two Metals.* **H. Moissan** and **O'Farrelley.** (Comptes Rendus, 138. pp. 1659–1664, June 27, 1904.)—The easy use of the electric furnace in the laboratory allows a great number of experiments to be made at high temperatures. Moissan has already [see Abstracts Nos. 940 and 1286 (1903)] volatilised by this means all bodies hitherto regarded as refractory. He has also used it to produce constant temperatures by boiling different metals. It is now applied to the study of the distillation of two metals whose boiling-points are different. To simplify the first experiments, metals have been chosen which do not furnish carbides at the temperature of the furnace, such as Cu, Zn, Cd, Pb, and Sn. In the early trials a definite weight of the alloy was heated gradually in a boat placed in a carbon tube. The type of furnace described in C. R. 117. p. 679, 1893, was utilised. Later the alloy was heated in an ordinary crucible, and samples removed for analysis. Finally a known weight of the alloy was heated in a covered crucible and the residue was submitted to analysis. The current used was from 450–500 amps. at 110 volts. Details of the effect of heating Cu and Zn, Cu and Cd, Cu and Pb, Cu and Sn, Sn and Pb are given. Three types of distillation of a mixture of two liquids are noted. Cu and Pb when they are distilled behave as a mixture of two liquids partially miscible, such as water and ether. On the contrary, a mixture of Sn and Pb is like a solution of water and alcohol. In the case of Cu and Sn the mixture resembles a solution of water and formic acid, and a constant temperature exists at which the vapours of the two metals possess the same vapour tension. The laws which govern the fractional distillation of two liquids apply to metals at very high temperatures. The experiments show that a mixture of Cu and Sn corresponding to SnCu [see Stead, Soc. Chem. Ind., Journ. 17. p. 3, 1898] has a constant boiling-point. Another important fact noticed is the difficulty of volatilising Sn as compared with Cu.

W. W. H. G.

2335. *Zirconium.* **E. Wedekind.** (Zeitschr. Elektrochem. 10. pp. 331–335, May 6, 1904. From the Chemisches Universitätslaboratorium, Tübingen.)—Zirconium is one of the elements difficult to obtain pure. Of the three modifications, the amorphous, the graphitoidal, and crystalline, the last possesses the greatest interest. It was first prepared by Troost in 1865 by heating potassium zirconium fluoride or sodium zirconium chloride (1 part) with aluminium (1·5 parts) in a gas furnace, later Franz (1870) used a mixture of $3KF, ZrF_4$ with Al. More recently Moissan obtained Zr by the reduction of ZrO_2 by carbon in an electric furnace. The author has now adopted the Troost-Franz method, using an electric furnace. The double fluoride of potassium and zirconium in fine powder was heated with an excess of grain aluminium in a small furnace with 90–100 amps. at 30–35 volts for 5–6 min. From the product a material resembling antimony may be separated out by the use of acids, alkalies, &c. Analysis shows that it is of the composition $ZrAl_3$. The chemical properties and crystal form are described. The second part of the research relates to the result of electrically smelting this substance, which is thereby converted into Zr_3Al_4. A number of analogous compounds are known, and the author discusses the formation of $TiAl_3$, Al_2B_4, Al_2B_{24}, Si_4Al_3, $CeAl_4$, $LaAl_4$ and others. By substitution of magnesium amorphous zirconium was obtained. W. W. H. G.

2336. *Crystallised Ammonium Sulphate, and the Position of Ammonium in the Alkali Series.* **A. E. H. Tutton.** (Chem. Soc., Journ. 83. and 84. pp. 1049–1074, Aug., 1903.)—It has been previously shown by the author that the morphological and physical properties of the crystals of the normal sulphates and selenates of potassium, rubidium, and cæsium gradually change as the atomic weight of the metal increases. Similar investigations on ammonium sulphate show that this salt occupies a position between the sulphates of rubidium and cæsium, and closely resembles the rubidium salt in solubility, molecular volume, distance ratios (topic axis), refractive indices, axial ratios of the optical ellipsoid, molecular refraction along the axis, mean refractive equivalent for the crystalline and also for the dissolved salt. All these properties are less changed by the replacement of the two potassium atoms by the ten atoms composing the two ammonium groups than they are by exchanging K_2 for Rb_2. The ammonium salt shows certain peculiarities in its properties, and the specific constants indicate the special nature of the ammonium radicle, but the molecular constants show that ammonium occupies a position in the alkali series immediately after rubidium. As regards the molecular and crystalline structure of the salts, one of two conditions must hold. Either the atoms have so much play in the molecule that the latter can take up eight other atoms without appreciably changing in dimensions, or else the crystalline elements are so loosely joined together—that is, the free space is so great in comparison with the quantity of substance in the total space determined by the distance ratios—that there is enough room for the material part of the molecule to be increased by eight atoms without displacing the centres of neighbouring molecules more than when a simple exchange of metals takes place. T. H. P.

2337. *Diffusion of Electrolytes in Colloids.* **G. Galeotti.** (Accad. Lincei, Atti, 12. pp. 112–119, Aug. 2, 1903.)—From mathematical considerations for which the original paper must be consulted, the author expands the formula of Nernst and Planck for the e.m.f. of a concentration cell, with reversible electrodes of the secondary type, to the form—

$$E = \frac{RT}{F}\,\frac{2u}{u+v}\,ln\frac{a_0 + a_1\varepsilon^{-k^2\pi^2t} - a_3\varepsilon^{-9\pi^2k^2t} + \ldots\ldots}{a_0 - a_1\varepsilon^{-k^2\pi^2t} + a_3\varepsilon^{-9\pi^2k^2t} - \ldots\ldots},$$

where R is the gas constant in electrical units, F the electrochemical equivalent, T the absolute temperature, u and v the velocities of migration of the kation and anion respectively, and $a_0 = (C_0 + C_1)/2$, $a_1 = 2/\pi\,.\,(C_0 - C_1)$,

$a_2 = 2/3\pi . (C_0 - C_1)$......, C_0 and C_1 being the concentrations of the battery solution. This formula is verified by a comparison of results calculated from it with those obtained experimentally on the diffusion of an electrolyte in a colloid, the colloid experimented with being gelatine purified by dialysis, and two forms of concentration cell being employed, viz., Hg, Hg_2Cl_2, c_0KCl, c_1KCl, Hg_2Cl_2, Hg and Ag, AgCl, c_0KCl, c_1KCl, AgCl, Ag. W. H. St.

2338. *Separation of Carbon Dioxide from Sodium Carbonate Solutions.* **F. W. Küster** and **M. Grüters.** (Zeitschr. Elektrochem. 9. pp. 679–682; Discussion, pp. 682–684, Aug. 20, 1903. Report read before the 10 Hauptversamml. d. deutsch. Bunsen Gesell., at Berlin, June 3–8, 1903.)—It is well known that sodium bicarbonate gives up carbon dioxide on exposure to the air, or when its solution is boiled. It is, in fact, only stable when in contact with carbon dioxide of which the partial pressure does not fall below a definite minimum value for each given temperature. It is less well known that similar considerations apply also to the carbonate. Unlike the bicarbonate, this is stable in air, but this is merely due to the fact that the pressure of carbon dioxide in the air is greater than that of the carbon dioxide liberated by the carbonate. A series of experiments is described in which electrolytic gas was led continuously through a solution heated to 25° or to 90°, and containing sodium carbonate with an excess of either carbonic acid (as bicarbonate) or of caustic soda; the carbon dioxide produced was absorbed and estimated. The two figures reproduced herewith show the volume of carbon dioxide carried forward from solutions, normal as regards total alkali, but containing varying amounts of carbon dioxide, by the electrolytic gas liberated by a current of 1 amp. Fig. 1 shows the behaviour at 25° C. of mixtures of bicarbonate and carbonate from 0 to 100 per cent. Na_2CO_3, in which the liberation of carbon dioxide steadily decreases as the percentage of bicarbonate decreases. Fig. 2 shows, on a much larger scale, the behaviour of mixtures containing only a small excess, or a small deficit, of carbon dioxide. Although the liberation of carbon dioxide is greatly reduced in presence of free caustic soda it is still appreciable up to 20 per cent. NaOH, 80 per cent. Na_2CO_3, when the temperature is raised from 25° to 90° C. T. M. L.

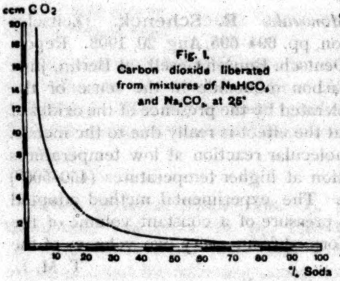


Fig. 1.
Carbon dioxide liberated from mixtures of $NaHCO_3$ and Na_2CO_3 at 25°

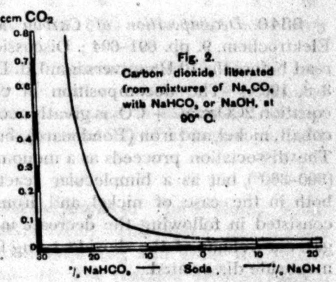


Fig. 2.
Carbon dioxide liberated from mixtures of Na_2CO_3 with $NaHCO_3$ or NaOH, at 90° C.

2339. *Colloidal Zirconium.* **E. Wedekind.** (Zeitschr. Elektrochem. 9. p. 630; Discussion, pp. 630–633, Aug. 6, 1903. Paper read before the 10 Hauptversamml. d. deutsch. Bunsen Gesell., at Berlin, June 3–8, 1903.)—

Zirconia is much more easily reduced by Al, and especially by Mg, in a crucible of Pt, Ni, or Cu, than by C, B, or Si; an electric furnace would be required in the latter case. Part of the reduced metal is obtained in colloidal form and can, after heating the residue with hydrochloric acid, be washed out with water, passing through the filter as a deep-blue liquid, opalescent in incident light. Renewed treatment with acid and water afterwards gives more of the solution which is not precipitated by electrolytes but by hydrogen peroxide, yielding black-greenish flakes. **G. Bredig** pointed out that an alloy of Zr and Mg was evidently formed and afterwards disintegrated, just as lead alloys give lead clouds; the periodic character is common to many reactions. **R. Lorenz** remarked that colloidal boron was not precipitated by electrolytes either, but it contained hydrogen. **O. Ruff** referred to silica. **K. Arndt** pointed out that, according to Jordis, pure silica does not give a colloidal solution, which exists, however, in the presence of sodium salts. **W. R. Whitney, A. Stähler,** and **E. Warburg** also discussed the paper. H. B.

2340. *Decomposition of Carbon Monoxide.* **R. Schenck.** (Zeitschr. Elektrochem. 9. pp. 691–694; Discussion, pp. 694–695, Aug. 20, 1903. Report read before the 10 Hauptversamml. d. Deutsch. Bunsen Gesell., at Berlin, June 3–8, 1903.)—The decomposition of carbon monoxide in the sense of the equation $2CO \rightleftharpoons C + CO_2$ is greatly acclerated by the presence of the oxides of cobalt, nickel, and iron (Boudouard), but the effect is really due to the metals. The dissociation proceeds as a monomolecular reaction at low temperatures (300–360°), but as a bimolecular reaction at higher temperatures (450–500°) both in the case of nickel and iron. The experimental method adopted consisted in following the decrease in pressure of a constant volume of the gas, one volume of the dioxide being formed from every two volumes of the monoxide dissociated. T. M. L.

2341. *Chemical Kinetics of Contact Sulphuric Acid.* **Bodenstein.** (Zeitschr. Elektrochem. 9. pp. 696–697; Discussion, p. 697, Aug. 20, 1903. Paper read before the 10 Hauptversamml. d. Deutsch. Bunsen Gesell., at Berlin, June 3–8, 1903.)—In the author's experiments on the catalytic combination of sulphur dioxide and oxygen to form sulphur trioxide, the decrease of pressure of the mixed gases ($2SO_2 + O_2$) at constant volume is used as a measure of the velocity of the reaction. The temperatures used are 246° and 264°, and the catalyser, platinum gauze, which does not absorb SO_2, O_2, or SO_3 in appreciable quantities, and can be readily cleaned by ignition. The diminution of pressure during any one experiment indicates that the reaction is between the third and second orders. In experiments with different initial concentrations the velocity of reaction is quite independent of the concentration of the oxygen, and, in the first stages, nearly proportional to $C^{\frac{1}{2}}_{SO_2}$. The SO_3 formed has a very strong retarding action on the process. The whole of the results obtained are well expressed by the formula: $dx/dt = k \,.\, C_{(2SO_2)}/[m + C_{(2SO_3)}]$, where m is a constant. This expression only holds so long as (1) the concentration of the oxygen does not amount to less than about one-fourth of that of the $2SO_2$, and (2) the activity of the platinum does not change. These results lead to the following conception of the mechanism of the reaction: In all cases the sulphur dioxide and oxygen must reach the phase where the high velocity of reaction prevails, *i.e.*, at the surface of the platinum. This occurs quickly—almost infinitely so, compared with the velocity of reaction—for the oxygen, so long as its concentration is not extremely small; this concentration hence plays no part. With the platinum oxide, or solution, adsorption, &c., of oxygen in platinum the sulphur dioxide reacts to form sulphur trioxide with the measured velocity. In this reaction "free" platinum—*i.e.*, platinum not charged with SO_3—need alone be considered. Supposing the platinum to combine with, or dissolve, or adsorb the sulphur trioxide, the "free" platinum is given by the expression: $Pt\ (free) = Pt\ (total)/(K + K \cdot C_{SO_3})$. For the whole reaction, assuming that only the "free" platinum catalyses, we have: $dx/dt = k \cdot Pt\ (total)/(K + K \cdot C_{SO_3})$, which is identical with the equation experimentally determined. T. H. P

2342. *Coefficient of Distribution of Hydrogen Peroxide between Water and Ether.* **K. Osipoff** and **S. Popoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 637–639, 1903.)—The following table gives the results obtained at 17·5°:—

Vol. of ether : vol. of water	½	1	2	5	6	7	8	9	10
$\frac{\text{Conc. of } H_2O_2 \text{ in ether}}{\text{Conc. of } H_2O_2 \text{ in water}}$	0·0575	0·0596	0·060	0·060	0·075	0·074	0·067	0·070	0·072

The distribution coefficients were also determined at 3° and 7°, and also the influence on them of sodium chloride and of sodium and potassium carbonates. The first of these produces no change in the coefficient, but both the carbonates cause a diminution in the solubility of hydrogen peroxide in ether. T. H. P.

2343. *Chemical Equilibrium.* **L. Pissarjewsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 35. pp. 1204–1215, 1903.)—The author has studied the reaction between silver and ferrous sulphates, and from the results obtained draws the following conclusions: (1) The reaction between Ag_2SO_4 and $FeSO_4$ reaches a state of equilibrium after 168 hours; the initial high velocity of the reaction diminishes extremely rapidly during the first 50 hours. (2) The constant of the equilibrium $Ag^{\cdot} + Fe^{\cdot\cdot} \rightleftarrows Ag + Fe^{\cdot\cdot\cdot}$ at 25° equals 0·00792 and the diminution of free energy + 2870 cals. (3) The heating effect of the reaction (diminution of total energy) is + 8683 cals. (4) Calculating by means of van't Hoff's formula, the constant becomes 1, and the diminution of free energy zero, at − 48·7°. (5) If the reaction takes place in normal sodium sulphate solution, the constant at 25° is 0·00326 and the diminution of free energy + 5,397 cals. The determination is only possible below 35° because at that temperature basic iron salts separate out, which exert an influence on the magnitude of the constant. T. H. P.

2344. *Behaviour of Platinum Amalgams with Nitric Acid.* **N. Tarugi.** (Gazzetta Chim. Ital. 33. 2. pp. 171–186, 1903.)—In a mixture of finely divided metals, such as is obtained by reduction from solutions of their salts, the individual metals do not retain the distinctive chemical properties which they possess in the free, unmixed condition. Especially is this so when mercury is present, as then amalgams are formed, the properties of which render inapplicable the ordinary method of separating the metals by means of acids. Thus, from a mixture containing 4·64 per cent. Pt and 95·35 Hg, nitric acid dissolves the whole of the Pt; as the percentage of Pt present increases, the proportion of the total amount dissolved by the acid diminishes, whilst the proportion of Hg dissolved decreases from 99 per cent. in a mixture of 91·11 parts Hg and 8·88 Pt to zero for a mixture of 17·02 per cent. Hg with 82·97 Pt. Microscopic examination confirms the fact that amalgams are formed during the simultaneous reduction of platinum and mercury from solutions of their salts. With a mixture of gold and mercury salts in solution, however, reduction by hydrazine does not lead to the formation of amalgams. T. H. P.

2345. *Mechanism of the Catalytic Action of Platinum Black.* **R. Vondráček.** (Zeitschr. Anorg. Chem. 39. 1. pp. 24–40, March 15, 1904. Techn. Chem. Laborat. der techn. Hochschule, Prag.)—The author finds that with platinum black (and all the platinum metals in a finely divided state) two forms must be distinguished : (*a*) Platinum black containing oxygen, and (*b*) oxygen-free platinum black. While the first of these has only an oxidising action the other is able to effect reductions. The first form is capable of oxidising solutions of ammonia and its salts with formation of nitrogen, while oxygen-free platinum black reduces solutions of nitrous and nitric acids, and in this way, as also by the action of the oxygen of the air, it regains its oxidising properties. In ammonia solutions platinum black becomes saturated with nitrogen, which may be subsequently expelled by the action of potassium hydroxide solution. It follows that the decomposition of ammonium nitrite solutions by platinum black takes place in two stages, in the first of which the oxygenised platinum oxidises the nitrite, while in the second the residual nitrous acid is reduced by the now oxygen-free platinum. T. H. P.

2346. *Soluble Colloidal Form of Ferric and other Phosphates.* **W. J. Sell.** (Cambridge Phil. Soc., Proc. 12. pp. 388–390, April, 1904.)—On thoroughly shaking a mixture, in certain proportions, of solutions of diammonium hydrogen phosphate and ferric chloride and adding ammonia solution until the liquid smells faintly of it, the white phosphate precipitate gradually becomes brown, and finally dissolves, giving a clear brown solution. After dialysis through parchment paper, the composition of the dissolved substance is found to be $FePO_4$ + a little hydroxide. The colloidal solution of ferric phosphate is tasteless and without action on litmus, and is gelatinised by various salts. Silver nitrate gives a precipitate consisting mainly of $FePO_4$; potassium sulphocyanide produces no colouration, and potassium ferrocyanide has only a coagulating action. The electrical conductivity of the solution is very slight. In a similar way were prepared colloidal phosphates of aluminium and chromium exhibiting analogous properties. T. H. P.

2347. *Complex Silver Salts.* **G. Bodländer** and **W. Eberlein.** (Zeitschr. Anorg. Chem. 39. 2. pp. 197–239, April 2, 1904. Elektrochem. Laborat. der techn. Hochschule, Braunschweig.)—To arrive at the formulæ of complex silver salts in solution, the authors make measurements of the e.m.f. of concentration cells of solutions of the complex compounds in presence of excess of the easily soluble component of the complex. A small amount of the complex ion, D, having the formula M_mR_n, is split up into its constituents, and at constant temperature, $D/M^mR^n =$ a constant ; this gives the ratio of the concentrations of the free metal ion in two solutions containing different amounts of complex ion and component R. This relationship, $M_1 : M_2$, can be determined from Nernst's formula for concentration cells. From the tables containing values for E and m for solutions of the same potassium iodide, and varying silver iodide content, it is seen that in the more dilute solutions the complex ion contains two atoms of silver, and that in solutions richer in potassium iodide, complex ions with only one atom of silver are also present. Measurements of concentration elements with equal amounts of silver iodide and varying quantities of potassium iodide show that in these solutions compounds of different formulæ are present, *e.g.*, $K_2Ag_2I_4$, $K_4Ag_2I_5$, $K_4Ag_2I_6$ and $K_5Ag_2I_7$, the existence of the middle ones being doubtful; in more concentrated solutions K_3AgI_4 is perhaps present. The concentration of Ag-ions in normal potassium iodide solution is $8{\cdot}9 . 10^{-17}$. Assuming that the salt $K_5Ag_2I_7$ is present, the dissociation constant of its ions $Ag_2I_7{'''''}$ has the value, $K = 8{\cdot}17 . 10^{-30}$, a value similar to that obtained from Hellwig's solubility determinations. Measurements of silver potassium thiocyanate cells indicate that the complex ion of these double salts contains only one atom of silver, and that the formulæ of the salts are $K_3Ag(KNS)_4$ and $KAg(CNS)_2$; it is unlikely that the ion $Ag(CNS)_3$ occurs. Salts of the type $K_3Ag(CNS)_4$ cannot pass into solution without being decomposed into $KAg(KNS)_2$ and KCNS, since they only exist in solution in presence of at least 0·2 mols. of KCNS. Measurements of silver potassium cyanide cells show that the solution contains the compounds $KAg(CN)_2$ and $K_2Ag(CN)_3$. Silver cyanide of the type AgCN is incapable of existence in aqueous suspension; the solid, stable silver cyanide has the formula $Ag \cdot Ag(CN)_2$. From this the authors arrive at an explanation of the fact that on esterification, potassium cyanide yields nitriles and silver cyanide isonitriles. The action of sulphuric acid on silver cyanide is expressed by: $H_2SO_4 + Ag \cdot Ag(CN)_2 = Ag_2SO_4 + 2CNH$. The best electrolyte for the silver voltameter is potassium silver cyanide, provided that no oxygen is present. The e.m.f. of silver towards a potassium cyanide solution of less strength than 0·05-normal, is given by: $E = 0{\cdot}444 - 0{\cdot}056 \log [Ag(CN)_2'] : [CN']^2$; this is less than for zinc, copper and gold in potassium cyanide solutions. The following table gives the stability constants of the various complex salts—

Complex Salt.	Stability.	Complex Salt.	Stability.
K_3AgCl_4 (?)	$5 . 10^5$	K_3AgI_4 (?)	$5{\cdot}5 . 10^{15}$
K_3AgBr_4 (?)	$8{\cdot}5 . 10^8$	$K_2Ag(CN)_3$	$9 . 10^{21}$
$K_3Ag(CNS)_4$	$1{\cdot}5 . 10^{11}$		

The order of the anions according to increasing tendency to form complexes is the same as in the preceding table. T. H. P.

2348. *Solubility of Oxygen in Sea-Water and in Water of Different Degrees of Salinity.* **F. Clowes** and **J. W. H. Biggs.** (Soc. Chem. Ind., Journ. 23. pp. 358–362; Discussion, pp. 362–363, April 15, 1904.)—Results are given of determinations of the solubility of atmospheric oxygen in waters intermediate between distilled and sea-water. The amount of oxygen dissolved by sea-water gradually increases when the water is repeatedly shaken with air at intervals of some days; the maximum power of solution is thus apparently reached only when the deoxidising agents present are removed. The amount of atmospheric oxygen dissolved diminishes regularly in proportion to the amount of sea-water present mixed with distilled water; the constituent of sea-water determining the solubility of the oxygen is the sodium chloride.

T. H. P.

2349. *Cacodylic Acid and Amphoteric Substances.* **P. T. Muller** and **E. Bauer.** (Comptes Rendus, 138. pp. 1099–1100, May 2, 1904.)—In contradistinction to Zawidzki [see Abstract No. 2408 (1904)] the authors support the view of Hantzsch [see Abstract No. 2410 (1904)] that cacodylic acid $(CH_3)_2AsO.(OH)$, dissociates normally. The difference between the molecular refractions in aqueous solution (for D) of the acid and its sodium salt is 1·58, which number is characteristic of ordinary weak carboxylic acids. Furthermore, the heat of neutralisation of cacodylic acid by caustic soda, as determined by Imbert, is 14·11 cal., which leads to the value + 0·4 cal. for the heat of ionisation of the acid. It results from this that the temperature-coefficient of the dissociation-constant of the acid agrees with that of ordinary acids. It follows from this that cacodylic acid and its sodium salt do not differ in constitution, and that an amphoteric acid need not necessarily be a pseudo-acid. F. G. D.

2350. *Calcium Sulphate in Aqueous Solutions of Potassium and Sodium Sulphates.* **F. K. Cameron and J. F. Breazeale.** (Journ. Phys. Chem. 8. pp. 335–340, May, 1904.)—The solubility of calcium sulphate in solutions of potassium and sodium sulphates was determined at 25°, also the amounts of calcium sulphate dissolved when syngenite, $CaK_2(SO_4)_2, H_2O$ is shaken up with solutions of potassium sulphate at 25°. The results are shown on the accompanying diagram. The figures for the calcium sulphate-potassium sulphate series indicate two curves, the intersection of which gives the stable triple-point where the solution is in equilibrium with both gypsum and syngenite, as solid phases. Following van't Hoff and Wilson's method, the values for this point found by extrapolation agree with the observed values. [See Abstract No. 439 (1904).] F. S.

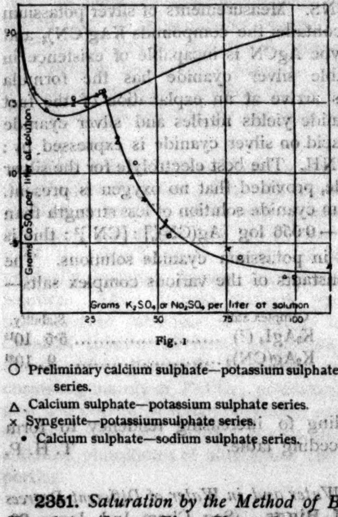


Fig. 1

○ Preliminary calcium sulphate—potassium sulphate series.

△ Calcium sulphate—potassium sulphate series.

× Syngenite—potassiumsulphate series.

• Calcium sulphate—sodium sulphate series.

2351. *Saturation by the Method of Bubbling.* **H. R. Carveth and R. E. Fowler.** (Journ. Phys. Chem. 8. pp. 313–324, May, 1904.)—The authors compare the amount of water removed from a weighed tube by bubbling dry air through it, with that contained by the same air after passing from supersaturation to the saturated state. This is accomplished by passing the dry, warmed air through (1) three weighed U-tubes containing water at 63°, (2) a Liebig bulb with water at 75°, (3) an empty U-tube at 63°, (4) a large U-tube containing glass wool moistened with water, (5) a small U-tube with moist glass wool, (6) two weighed U-tubes containing concentrated sulphuric acid, and (7) another sulphuric acid bulb outside the apparatus. The results indicate that the ordinary method of bubbling air through a solvent or solution to produce complete saturation with air is very inaccurate, as in these experiments more water was given up by the saturated air than was taken from the first vessels by the dry air. Only with very special precautions can absolute saturation be obtained. It is shown also that conditions of supersaturation are easily obtainable which are not readily displaced to equilibrium by the presence of an excess of the solute phase. W. H. Si.

2352. *Solubility of Hydrogen and Nitrous Oxide in Aqueous Solutions of Differently Dissociated Substances.* **W. Knopp.** (Zeitschr. Phys. Chem. 48. pp. 97–108, May 10, 1904.)—The different substances were chloralhydrate. NH_4NO_3, KNO_3, $NaNO_3$ KCl, and propionic acid. The theoretical formulæ deduced by Jahn for the influence of non-electrolytes in modifying the solubility, viz.: $\frac{C'_1}{C_1} = 1$ and $\frac{1}{n_2} \log \frac{C'_1}{C_1} =$ const., where $C_1 =$ molecular concentration of a gas in pure water $C'_1 =$ concentration in the solution, $n_2 =$ concentration of the non-electrolyte in gm.-mols. per litre were tested. The first formula applies to very dilute solutions, the second to non-dilute solutions. Strange to say, however, in the case of chloral hydrate, the first formula appeared to hold good even for concentrated solutions (up to about ten times normal). For the electrolytes, Jahn's theoretical formula $\frac{1}{C} \log \frac{C'_1}{C_1} = (1 - a) A + a 18$, where $C =$ molecular concentration of electrolyte, $a =$ degree of dissociation, and A and B are temperature-functions, appeared to represent the results fairly well. F. G. D.

2353. *Kinetic Study of the Reaction between Bromine and Acetaldehyde in Aqueous Solution.* **S. Bugarszky.** (Zeitschr. Phys. Chem. 48. pp. 63–86, May 10, 1904. Chemical Lab. of the veterinary Hochschule in Budapest.)—The author first shows by qualitative tests and exact measurements, that the reaction which occurs is expressed by the equation $C_2H_4O + Br_2 + H_2O \longrightarrow 2HBr + CH_3.COOH$. So long as the bromine concentration is sufficiently low, the course of the reaction follows the bimolecular type. At higher bromine concentrations, the bimolecular velocity-coefficients decrease during the course of the reaction, and the author shows that this is due to the formation of HBr_3. When this is taken into account, *i.e.*, when the equilibrium $Br_2 + HBr \rightleftharpoons HBr_3$ is allowed for, very complicated expressions are obtained, but they are found to represent the velocity of the reaction with a sufficient degree of accuracy. An increase of 10° increases the velocity-coefficient in the ratio 1 : 2·55. Both experimentally and mathematically this research is exceptionally good. F. G. D.

2354. *Velocity of Diffusion of Water through a Semi-permeable Membrane.* **J. Šebor.** (Zeitschr. Elektrochem. 10. pp. 347–358, May 13, 1904. Paper read before the Königl. Gesell. der Wiss. Prague. Chem. Lab. der k. k. böhm. Tech. Hochschule.)—In a series of experiments with cane sugar, glucose, and mannitol, it was found that in all cases the velocity with which water passes through the walls of any given semi-permeable membrane is proportional to the osmotic pressure of the solution contained in the cell. This is true not only for variable concentrations of any one sugar, but also for the series of sugars. It is therefore possible, from measurements of the velocity of diffusion in a cell that has been calibrated by means of a known solution, to deduce the osmotic pressure of an unknown solution and hence the molecular weight of the solute. As an example of this method the osmotic pressure of solutions of barium chloride, raffinose and dextrine were calculated from the velocity of diffusion. Experiments were also made on the influence of temperature on the velocity of diffusion. These experiments showed that the velocity of diffusion increased much more rapidly than the osmotic pressure, and this result is attributed to the decreasing complexity of the water molecules. The velocities are correlated with the "degrees of dissociation" of water at different temperatures as calculated by Kohlrausch and Heydweiler, but it is not obvious what significance is to be attached to these somewhat fictitious quantities. T. M. L.

2355. *Indicators and the Concentration of Hydrogen Ions in Solution.* **E. Salm.** (Zeitschr. Elektrochem. 10. pp. 341–346, May 13, 1904.)—Friedenthal has shown [see Abstract No. 1535 (1904)] the possibility of finding the $H^{\cdot}$ concentration colorimetrically with indicators. This requires a series of solutions with the $H^{\cdot}$ concentrations in varying stages. The author measured the e.m.f. of hydrogen electrodes in his solutions and from this calculated the $H^{\cdot}$ concentration by the Nernst formula. The greatest concentration was obtained with hydrochloric acid solution; three lower stages were made by diluting the acid till it was 0·0001 N. Six more stages were formed by von Szily's method of mixing varying amounts of $\frac{N}{10}$ NaH_2PO_4 and $\frac{N}{10}$ Na_2HPO_4. The lowest stages were obtained by successively stronger solutions of caustic potash up to $3{\cdot}3\ N = 3{\cdot}1 \times 10^{-15}\ H^{\cdot}$. The concentration of $H^{\cdot}$ in the weakest hydrochloric acid was 1×10^{-4}. With these solutions the value of an indicator for titrating can be readily determined. Contrary to the statement of Salessky [see Abstract No. 1212 (1904)], the colour change does depend on the concentration of the indicator. So in all his experiments the author took 10 ccm. of the $H^{\cdot}$ solution and added 0·1 ccm. of a $\frac{N}{100}$ indicator solution. A table is given showing the colour produced with several indicators with each of the 17 stages. With the most delicate indicators, the neutral region is restricted to the smallest number of stages; to this class belong neutral red, *p*-nitrophenol, alizarine, alizarine-green, tropoeoline, and sodium alizarine-sulphonate. Cyanine is very delicate, but the changes are not instantaneous. The author concludes with a criticism of the work of B. Fels and Salessky in this direction. F. S.

2356. *Volumes of Solutions.* **W. F. Magie.** (Phys. Rev. 18. pp. 449–452, June, 1904. Abstract of paper read before the American Physical Society, April 22, 1904.)—The author shows that the volume of a solution of an electrolyte in water may be represented by the equation $V = W + A(n - p) + Cp$, where W is the volume of water used, n the number of gm. molecules of solute, p the number of these gm. molecules dissociated, and A and C are quantities which depend respectively on the undissociated molecules of the solute, and on the dissociated ions. If $n = 1$, p represents the dissociation factor, and $C - A = B$, whence $V = W + A + Bp$. The validity of this formula is confirmed by the close agreement between volumes observed experimentally and those calculated by means of the formula from the data of MacGregor, Kohlrausch and Hallwachs, and Thomsen. Experiments show that for each solute A and B are constants over a considerable range of dilution. W. H. St.

2357. *Decomposition of a Mixture of Calcium Carbonate and Alkaline Carbonate.* **P. Lebeau.** (Comptes Rendus, 138. pp. 1496–1498, June 13, 1904.)

—It has been shown [see Abstracts Nos. 1283 (1903) and 447 (1904)] that the alkaline carbonates can be completely dissociated under the action of heat in a vacuum. This dissociation, very marked at 800°, is produced very rapidly towards 1,100–1,200°. The effect of admixture of calcium carbonate has now been studied. In the first experiment the mixture consisted of $CaCO_3$ 1 part, and Ca_2CO_3 3 parts. The temperature was raised to 1,200° and the vacuum was maintained continuously. When the CO_2 ceased to be liberated the experiment was stopped. The residue consisted of irregular, transparent fragments of lime having no action on polarised light. Experiments of a like kind were made with mixtures of $CaCO_3$ and the carbonates of Rb, K, and Na. The conclusions drawn from the work are: (1) In the neighbourhood of 1,000° the reactions are complete. (2) Decomposition is not so easy as with $CaCO_3$ alone. (3) The residue of CaO is crystalline, and is not so easily attacked by reagents as ordinary CaO obtained by simple calcination of $CaCO_3$. In water it preserves for a long period its transparency.

W. W. H. G.

2358. *Mixtures Isomorphous with Calcium and Lithium Carbonates.* **P. Lebeau.** (Comptes Rendus, 138. pp. 1602–1604, June 20, 1904.)—Lithium carbonate heated in a vacuum with calcium carbonate behaves differently to the other carbonates mentioned in the former paper [see preceding Abstract]. The product of the decomposition always contains lithium, as shown in the table:—

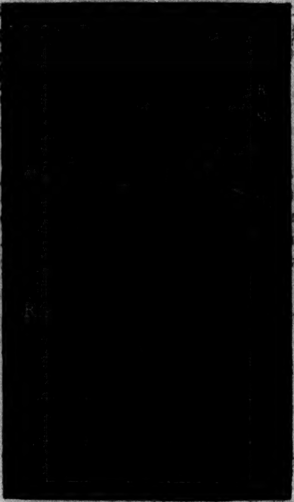
Initial Composition of Mixture (Calculated as Oxides).	Temperature of Heating.	Time of Heating.	Final Composition of Product.
$CaO + 2{\cdot}46\ Li_2O$.........	1,200°	7 hours	$CaO + 0{\cdot}24\ Li_2O$
$CaO + 2{\cdot}36\ Li_2O$.........	1,100	6	$CaO + 0{\cdot}53\ Li_2O$
$CaO + 2{\cdot}35\ Li_2O$.........	1,350	4	$CaO + 0{\cdot}16\ Li_2O$
$CaO + 1{\cdot}61\ Li_2O$.........	1,200	3	$CaO + 0{\cdot}76\ Li_2O$

The product consists of transparent crystals. The form is in regular octahedra isomorphous with chalk and lithium carbonate. With water they act as the CaO obtained as in the previous Abstract. Their formation may perhaps be explained by the solubility of the oxides in the fused carbonates, from which they deposit slowly as the dissociation proceeds. The measurement of the tension of dissociation of the alkaline carbonates with $CaCO_3$ support the theory of the formation, in the fused mixture, of double carbonates possessing a definite dissociation tension, as the following table shows:—

Temp.	Tension of Dissociation of Li_2CO_3.	Temp.	Tension of Dissociation of $CaCO_3$, Li_2CO_3.	Temp.	Tension of dissociation of $CaCO_3$ (Chatelier).
610°	1 mm.	420°	1 mm.	547°	27 mm.
620	3	630	5·4	610	46
710	16	690	11	625	56
800	29	790	70	810	678
890	41	860	128	812	763

An attempt has been made to isolate a double carbonate of lithium and calcium by fusing in a platinum boat placed within a glass tube through which a current of dry CO_2 was passed, a mixture formed of 1 molecule of $CaCO_3$ and 2 molecules of Li_2CO_3. A perfectly limpid liquid results, which solidifies into a white crystalline mass. By digestion with a small quantity of cold water the matter becomes friable, and when examined under the microscope the residue is seen to be formed of small needle-shaped crystals, quite different to those of the carbonates of calcium and lithium. They are decomposed by an excess of water. W. W. H. G.

2359. *Equilibrium between Chlorocamphor and Bromocamphor.* **M. Padoa.** (Accad. Lincei, Atti, 13. pp. 723–732, June 19, 1904.)—Ordinary α-brom- and α-chlor-camphor are both monoclinic and both isomorphous; also they form solid solutions. Yet, exceptionally, the velocity of crystallisation of the bromocamphor appeared (according to previous experiments) to be increased by the addition of chlorocamphor. A full investigation has now shown that the two substances are really isodimorphous, and give two distinct series of mixed crystals in all proportions—the one series monoclinic, the other monometric. There exists (see the accompanying Fig., which summarises the results obtained) a triple point (TT$_1$T$_2$) at 75·6° where liquid, monoclinic crystals, and monometric crystals (all containing about 40 per cent. of bromocamphor) coexist. In T the freezing-point curves MT, M$_2$T, and RT converge. M$_2$T is a labile curve which has not been actually realised experimentally; it would be formed by the points of fusion of the enantiotropic mixtures, which must have such points of fusion higher than the transformation points situated on M$_1$T$_2$. In the point T$_2$ the conjugate curve RR$_1$ and the transformation curve M$_1$T$_2$ cut one another. In the field l we have liquid mixtures; in r monometric, mixed crystals; in m, *i.e.*, below the line MTM$_1$, all the mixtures are in the state of monoclinic solid solutions; moreover below R$_1$T$_2$M$_1$ all the mixtures can exist in the labile condition as monometric forms. The system thus presents this special character that all the mixtures are dimorphous; at the multiple point we have the passage from dimorphous monotropic mixtures to dimorphous enantiotropic mixtures. D. H. J.

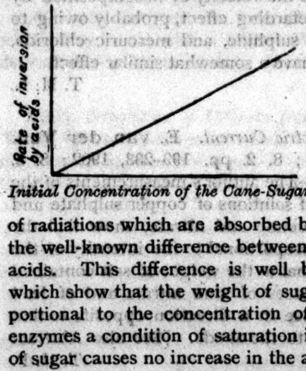


2360. *Polyacid Salts of the Rosanilines.* **J. Schmidlin.** (Comptes Rendus, 138. pp. 1508–1510, June 13, 1904.)—The brown rosaniline salts described by Hofmann are found to retain hydrochloric acid in solution, which on exposure for a month in vacuo in the presence of potash, completely volatilises, leaving the tri-acid salts black and odourless. In this way the tri-hydrochlorides of rosaniline, pararosaniline, and hexamethyl pararosaniline have been obtained. These salts dissolve in water or alcohol with the same colour as the monacid salts, and their colouring properties are not diminished by the saturation of all the basic radicles of the molecule, showing the theory to be untenable that the change in colour which solutions of the monacid salts undergo is due to the formation of di- and tri-acid salts. A red penta-hydrochloride is obtained by saturating fuchsine with hydrochloric acid gas at ordinary temperature and pressure, while if the temperature is lowered the red product absorbs more hydrochloric acid, becoming first orange, and at −70° pale yellow. At this point the hydrochloric acid absorbed corresponds to a body intermediate between a hexa- and a hepta-hydrochloride. At very low temperatures the colour completely disappears, the red salt changing immediately to white on plunging it into liquid air, and hydrochloric acid gas being passed into it all the time. W. H. Si.

2361. *Experimental Determinations for Saturated Solutions.* **Berkeley.** (Roy. Soc., Proc. 73. pp. 435–436, June 22, 1904. Abstract.)—As part of a research on the physical constants of concentrated solutions necessary for the application of the gas-law equations, the author has determined the densities of saturated solutions of the chlorides, sulphates, and nitrates of Na, K, Rb, Cs, and Tl, and of their respective alums except that of sodium, at temperatures ranging from 0° to 90° C., the observations being made at intervals of 15°, and the corresponding solubilities being also determined. W. H. Si.

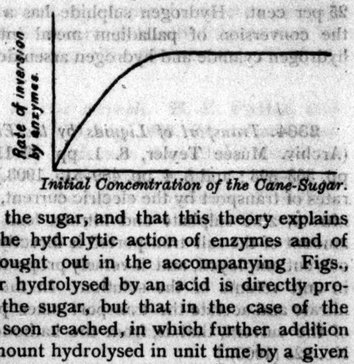
2362. *Enzyme Action.* **H. P. Barendrecht.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 2–18, June 24, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, May 26, 1904; Zeitschr. Phys. Chem. 49. pp. 456–482, Sept. 13, 1904.)—The author considers that the action of enzymes depends on the emission of radiations which are absorbed by the sugar, and that this theory explains the well-known difference between the hydrolytic action of enzymes and of acids. This difference is well brought out in the accompanying Figs., which show that the weight of sugar hydrolysed by an acid is directly proportional to the concentration of the sugar, but that in the case of the enzymes a condition of saturation is soon reached, in which further addition of sugar causes no increase in the amount hydrolysed in unit time by a given quantity of enzyme. A number of experiments are described, but it is very difficult to say what value these may possess when separated from the somewhat curious theory which dominates the whole paper. T. M. L.

FIG. 1.



Initial Concentration of the Cane-Sugar.

FIG. 2.



Initial Concentration of the Cane-Sugar.

2363. *Palladium Catalysis of Hydrogen Peroxide.* **G. Bredig** and **M. Fortner.** (Ber. Deut. Chem. Gesell. 37. pp. 798–810, 1904.)—The temperature employed was 25°, the hydrogen peroxide was titrated with permanganate, and the colloidal palladium was prepared by electrical powdering of palladium wire under N/1000 sodium hydroxide. The action is unimolecular and obeys a simple logarithmic law, but different preparations of palladium of the same concentration vary considerably in their activity. The catalytic action of the palladium (in presence of N/60 sodium hydroxide and N/10 hydrogen peroxide) can be distinctly noticed when the concentration of the palladium is only 1 gm. atom to 26 million litres of solution. Alkalies have an accelerating effect which reaches a maximum at intermediate dilutions, as is shown by the following table, which gives the times t_{50} for 50 per cent. decomposition at different concentrations :—

N/100000 Pd + N/10 H_2O_2.

+ NaOH.	N.	N/2.	N/4.	N/16.	N/64.	N/256.
t_{50} (minutes)	48	28	15	10	19	33

In acid solutions the decomposition is exceedingly slow. Hydrogen considerably increases the activity of the palladium ; in one experiment the amount of decomposition in 18 min. was increased from 25 to 96 per cent. by bubbling a little purified hydrogen through the colloidal palladium suspension. This effect is much too great to be due to oxidation of the absorbed hydrogen by hydrogen peroxide, and must depend on some alteration in the surface of the palladium. Prolonged action of hydrogen coagulates the palladium, with formation of a hydrogen alloy, but when this is oxidised again by hydrogen peroxide, the palladium or its oxide obtained is naturally in a still finer state of division, and the active surface therefore increased. Carbon monoxide at first retards and then greatly accelerates the catalytic action of the palladium ; this is explained as being due to the "poisoning" of the metal by carbon monoxide and subsequent oxidation to carbon dioxide, leaving the metal in a state of increased activity. Iodine acts as an anticatalyst ; the addition of N/107 iodine to N/13200 palladium reduced the velocity of decomposition by 25 per cent. Hydrogen sulphide has a retarding effect, probably owing to the conversion of palladium metal into sulphide, and mercuric chloride, hydrogen cyanide and hydrogen arsenide have a somewhat similar effect.

T. M. L.

2364. *Transport of Liquids by the Electric Current.* **E. van der Ven.** (Archiv. Musée Teyler, 8. 1. pp. 93–119 ; 8. 2. pp. 199–238, 1902 ; 8. 3. pp. 363–398 ; and 8. 4. pp. 489–515, 1903.)—The author's measurements of the rates of transport by the electric current, of solutions of copper sulphate and nitrate, zinc sulphate and nitrate, lead acetate and nitrate, show that the amount of the salt transported is directly proportional to the intensity of the current employed, and inversely proportional to the weight of salt contained in unit volume of the solution. In the cases of zinc nitrate and of lead nitrate and acetate the transport takes place in a direction opposite to that of the current, that is, from the kathode to the anode. [See also Abstract No. 525 (1900).]

T. H. P.

2365. *Deposition of Zinc from Zinc Chloride dissolved in Acetone.* **H. E. Patten.** (Electrochem. Ind., N.Y. 1. p. 418, Aug., 1903. Paper read before the Amer. Chemical Society.)—During the electrolysis of a saturated solution of zinc chloride in acetone, no gas bubbles appear at either electrode ; chloroform, chlor-acetone, or alkyl chlorides form at the anode, and a smooth, compact coating of zinc on the kathode. With a current density of 2·25 amps. per sq. ft. the zinc may be deposited steadily, whilst with 40 amps. per sq. ft. the zinc "trees out" from the edges of the kathode in long streamers. The thickness to which zinc may be deposited from this solution has not yet been ascertained, but the chief difficulty—the liberation of hydrogen upon the kathode and consequent pitting of the coat—is removed.

T. H. P.

2366. *Deposition of Metallic Calcium from Alcoholic Solutions.* **H. E. Patten.** (Electrochem. Ind., N.Y. 1. p. 418, Aug., 1903. Paper read before the Amer. Chemical Society.)—With a solution of calcium chloride in alcohol the addition of water is found to facilitate the deposition of the metal on electrolysis. This effect of water, which acts with great vigour on calcium, serves to emphasise the fact that the action of a solution upon a metal is not the prime factor in determining whether the metal can be deposited from the solution. In the case of an amyl alcohol solution of calcium chloride the addition of water increases the conductivity, but not sufficiently to raise the current density to the point where calcium is deposited. T. H. P.

2367. *Rôle of Water in the Electrodeposition of Lithium from Pyridine and from Acetone.* **H. E. Patten** and **W. R. Mott.** (Electrochem. Ind., N.Y. 1. pp. 417–418, Aug., 1903. Paper read before the Amer. Chemical Society.) —A considerable variation in the decomposition point of solutions of lithum chloride in pyridine, noticed by the authors in determining the current-e.m.f. curve, is shown to be due to the presence of an undue amount of moisture, which causes the formation of a high resistance film upon the kathode. The electrolysis of anhydrous pyridine solutions of lithium chloride proceeds quite regularly. Lithium can be deposited from a solution of the chloride in acetone, which need not be highly anhydrous, although, as lithium reacts with water, the more anhydrous the solution the better. This metal deposits equally well on platinum, iron, aluminium, or copper, in an even coating which may be cut with a knife. With low current-density lithium may be deposited from butyl alcohol. [See also Abstract No. 2070 (1904).] T. H. P.

2368. *Deposition of Lithium from Various Alcohols.* **H. E. Patten** and **W. R. Mott.** (Electrochem. Ind., N.Y. 1. p. 419, Aug., 1903. Paper read before the Amer. Chemical Society.)—A summary is given of the authors' results on the deposition of lithium from solutions of the chloride in ethyl, propyl, butyl, and amyl alcohols. The solutions need not be highly anhydrous. For ethyl, propyl, and amyl alcohols a high current-density must be used, although the current-e.m.f. curves give a decomposition point at 4·0 volts, even with a low current-density. Butyl alcohol appears to be the best solvent from which to deposit lithium, although the solution has a low conductivity compared with that of the ethyl and propyl alcohol solutions. Allyl alcohol and glycerine solutions of lithium chloride give no recognisable deposits of the metal, even at a high current-density. T. H. P.

2369. *Deposition of Sodium from a Solution of Sodium Iodide in Acetone.* **H. E. Patten** and **W. R. Mott.** (Electrochem. Ind., N.Y. 1. p. 419, Aug., 1903. Paper read before the Amer. Chemical Society.)—Sodium iodide in acetone solution is decomposed at a low voltage and low current-density, but a high current-density (3·64 — 5·17 amps. per sq. cm.) is required to deposit sodium from the solution. The specific conductivity of the solution employed is found by the Kohlrausch method to be 0·231 at 25° C.; the remarkable magnitude of this is shown by comparing it with the value for a 0·02-normal solution of potassium chloride in water, namely, 0·00277. Hydrogen is copiously evolved from the kathode, owing to secondary action of the sodium there deposited upon the acetone. The above experiment was made without a diaphragm, although one may be employed, but at the expense of a considerable amount of energy. In general, the phenomena observed during the electrolysis in acetone solutions are analogous to those in aqueous solutions. Where the metal deposited does not react with acetone, hydrogen is not given off during the deposition of the metal at a low current-density; this is the case, for instance, in the deposition of zinc from zinc chloride dissolved in acetone. T. H. P.

2370. *Electrochemistry of the Compounds of Iodine and Oxygen.* II. **E. Müller.** (Zeitschr. Elektrochem. 9. pp. 707–716, Aug. 27, 1903. From the Elektrochem. Laborat. der K. Sächs. Techn. Hochschule, Dresden.)—A graphical method is given for representing the changes of free energy accompanying the reactions between the different stages of oxidation of iodine. The conclusion is drawn that a lower and a higher stage of oxidation can only react to form a given intermediate stage when all the reactions yielding the other intermediate compounds are accompanied by loss of energy. An instance of this is seen in the formation of iodate from periodate and iodine ions, which do not react in alkaline solutions, most likely because the reaction of these substances to form another intermediate compound (iodine) is attended by increase of free energy. This is not the case in acid solutions, or in presence of platinum black, or in light, or at high temperatures, any of which conditions causes the reaction to take place. [Compare Abstract No. 2074 (1904).]

T. H. P

2371. *Atomic Weight and Electrochemistry of Indium.* II. **A. Thiel.** (Zeitschr. Anorg. Chem. 39. 1. pp. 119–120, March 15, 1904. Chem. Institut der Bergakademie, Clausthal, Jan. 25, 1904.)—The value, less than 114, previously given to the atomic weight of indium is too small, the later researches of the author on the bromide giving the number 114·81 ± 0·07. Indium salts readily undergo hydrolytic dissociation in solution. Potential measurements show that the solution tension of In$^{\cdots}$-ions is so great that it comes between iron and lead. The metal is quantitatively precipitated on silvered platinum kathodes. The close relation existing between indium and aluminium is borne out by a similarity in the taste of their salts.

T. H. P.

2372. *Electrolysis of Potassium Double Cyanides.* **H. v. Hayek.** (Zeitschr. Anorg. Chem. 39. 2. pp. 240–256, April 2, 1904. Elektrochem. Laborat. d. techn. Hochschule, Berlin-Charlottenburg).—The author gives the result of his examination of the electrolytic oxidation of potassium ferrocyanide, made in order to discover the conditions under which the oxidation is complete and the influence of concentration on the current yield and density. The anode liquid should be constantly stirred and should be kept alkaline to avoid the formation of free hydroferrocyanic acid. The anode space should be twice as great as that of the kathode, and the rotating anode should have as large a surface as possible; the electrodes employed by the author are of nickel. It is found that a current yield of 100 per cent. can be obtained and that the concentration of the electrolyte, within wide limits, exercises no influence on the yield. The limit to which the concentration of the total electrolyte may be diminished becomes greater as the initial concentration increases, but the limit to which the concentration of the anode solution may be taken is independent of the initial concentration and of the quantity of potassium ferrocyanide formed. Further, the increase of the current density beyond a certain limit—the concentration remaining constant—gives rise to secondary processes which increase rapidly in intensity, whilst the current-yield sinks accordingly. This maximum current density increases with the concentration. The secondary processes which set in when this limit is exceeded are: (1) Decomposition of water by the anion, $Fe(CN)_6$, and the consequent neutralisation of free alkali at the anode; (2) the electrolytic decomposition of the ferrocyanide formed; and (3) of the potassium hydroxide present. The electrolysis of potassium manganicyanide, $K_3Mn(CN)_6$, gives first the ions K_3 and $Mn(CN)_6$, the final product of the kathodic reduction being manganous hydroxide. The anion $Mn(CN)_6$ is appreciably less stable than $Fe(CN)_6$. When potassium nickelcyanide is electrolysed, it is first dissociated into the ions K and $Ni(CN)_4$, the final product of the kathodic reduction being an unstable substance rapidly changing into the original double cyanide. The anion $Ni(CN)_4$ is only slightly stable and it splits up readily into $Ni(CN)_2$ and CN_2. Potassium cobalticyanide undergoes electrolytic dissociation into the ions K_3 and the unstable $Co(CN)_6$. A more marked oxidation occurred at the anode in this case, oxides of nitrogen and ozone being formed. T. H. P.

2373. *Bell Method of Electrolysis.* **O. Steiner.** (Zeitschr. Elektrochem. 10. pp. 317–331, May 6, 1904. Communication from the Chem.-tech. und Elektrochem. Institut der Grossherzogl. techn. Hochschule, Darmstadt.)—The various patented processes in which a bell encloses the anode are described. Next the first investigations on the method by G. Adolf [see Abstract No. 1752 (1901)], and the later work by Foerster and others is discussed. After a general theoretical examination of the process, the author proceeds to describe his own experiments. For trials when the working was discontinuous the apparatus consisted of a cylindrical glass bell-jar of 0·6 sq. dcm. horizontal cross-section, which was placed within an outer glass vessel. Two kathodes of nickel plate 9 cm. long and 6 cm. broad were fixed so that their lower ends were 1 cm. above the lower edge of the bell. The anode was a horizontal platinum net of 50 sq. cm. surface. The distance of the lower anode surface from the lower edge of the bell was 6 cm. Three sets of experiments were made with 15, 24, and 28 per cent. of neutral KCl solutions as the electrolyte, and the position of the neutral layer, the yield of alkali, and other points were observed. The results are tabulated and exhibited graphically. The second part of the work relates to the technically more important case when the process is arranged as a continuous one. Various electrodes were tried, and include retort carbon, Lessing's carbon, and Acheson's carbon, and different types of electrolysers were used. In the case of continuous working, among the conclusions drawn are the following: (1) A current efficiency of 85–94 per cent., an alkaline solution of 120–180 gm. KOH per litre, and 97–100 per cent. chlorine gas may be obtained with a current density of 2–4 amps. per sq. dcm. of horizontal bell cross-section, using 3·7–4·2 volts. (2) It is better for the anode materials, as well as for the production of pure chlorine gas and a good current efficiency, that the inflowing solution should be distributed uniformly. (3) In the case of anodes of artificial carbon, a colourless alkaline solution can be obtained by filtration through sand. (4) The distance of the neutral layer from the level of the lower run of the bell will be the greater, the smaller the concentration of the inflowing solution and the current density. (5) The vertical distance of the bottom of the anode from the level of the bell-rim is, for the practical application of the process, of importance. It must be so great that the neutral layer is at least 1 cm. below the anode. It must be greater, the higher the final alkali concentration, and smaller the percentage of the chloride in the inflowing solution. When the current density is small and distribution of the inflowing solution is not regular, the distance must also be greater. For 27·5 per cent. KCl solution, when the method of distribution of the liquid described in the paper is followed, and for an alkaline solution of about 180 gm. KOH per litre, with a current density of 2–4 amps. per sq. dcm. of horizontal bell cross-section, the minimum distance is 4–5 cm. W. W. H. G.

2374. *Copper Voltameters in Accurate Determinations.* **I. Adams** and **B. MacNutt.** (Amer. Electrochem. Soc., Trans. 5. pp. 191–198; Discussion, pp. 198–199, 1904.)—In determining the horizontal component of the earth's magnetic field, a copper voltameter was used. In work of this high degree of accuracy, allowances were made as follows: With a copper kathode surface of 50 sq. cm., about 0·2 mgm. of the deposit is dissolved by the electrolyte (slightly acid solution of copper sulphate) before the current can be switched on. Also in the time taken to reverse the current through the galvanometer there was an increase of polarisation. After each reversal this rate of increase is large, but falls off with time till the next reversal, when there is a large increase of polarisation followed by a diminishing rate of increase of polarisation, and so on. **C. Hering**, in the *discussion*, deprecated the use of copper voltameters for accurate work. F. S.

2375. *Electrochemical Preparation of Hyposulphites.* **K. Elbs** and **K. Becker.** (Zeitschr. Elektrochem. 10. pp. 361–364, May 20, 1904. Phys.-Chem. Universitätslaborat., Giessen, April, 1904.)—Dilute solutions of the hyposulphite $Na_2S_2O_4$ can readily be produced by electrolysing sodium bisulphite, $NaHSO_3$, in a closed vessel containing a closed clay cell—to prevent oxidation—filled with Na_2SO_4, H_2SO_4, or NaOH. Nickel-wire electrodes are attacked, lead electrodes coated with sulphur, platinum grids, or perforated aluminium answer best. After 1 amp.-hour, the formed $Na_2S_2O_4$ is decomposed under formation of thiosulphate, $Na_2S_2O_3$, and the yield of 89 per cent. is diminished; the current density was 2·5 amps. per sq. dcm., temperature 20° C.; with weaker currents the efficiency falls off more rapidly. The resulting solution is sufficiently strong for the direct reduction, *e.g.*, of indigo, after Meister, Lucius, and Brüning. Some solid $Na_2S_2O_4$ was obtained by electrolysing a mixture of $NaHSO_3$ and $Zn(HSO_3)_2$ with a zinc kathode; Bernthsen's chemical method is much more convenient, however. The authors failed to obtain A. R. Frank's crystallised magnesium and calcium hyposulphite, and they doubt Frank's statement because they could only dissolve 9·3 gm. of $CaH_2S_2O_6$ in 1 litre of water. The authors use the terms hyposulphite and hydrosulphite indiscriminately. H. B.

2376. *Anodic Behaviour of Tin, Antimony, and Bismuth.* **K. Elbs** and **H. Thümmel.** (Zeitschr. Elektrochem. 10. pp. 364–367, May 20, 1904. Phys.-Chem. Universitätslaborat., Giessen, April, 1904.)—The investigation concerns the valency with which rod anodes of the metal are dissolved in solutions of NaCl, Na_2SO_4, HCl, H_2SO_4, in various concentrations at temperatures between 18 and 100° C., and with currents of from 1 to 100 amps./cm^2. Tin is essentially dissolved as a bivalent metal; not more than 10 per cent. of tetravalent tin are found. Antimony yields only trivalent compounds; the best solvents for it are NaCl and HCl. Bismuth is also dissolved exclusively as a trivalent element; in sodium sulphate the metal becomes covered with a grey, insulating layer which does not dissolve in potassium or ammonium sulphate, although the bismuth sulphate forms double-salts with those sulphates; for similar reasons sulphuric acid does not answer as electrolyte. For similar researches see Elbs and Fischer, Abstract No. 584 (1901), and Elbs, No. 868 (1903). H. B.

2377. *Single Potentials of the Halogen Elements.* **W. R. Mott.** (Amer. Electrochem. Soc., Trans. 5. pp. 73–82; Discussion, pp. 82–88, 1904.)—The author gives experimental data for the single potentials of fluorine, chlorine, bromine, and iodine, the numbers for which show the validity of the additive law for both anions and kathions. This law holds much better for dilute aqueous solutions than for solid salts. The latter may, in different forms, possess very different amounts of energy; for example, amorphous silver iodide has a heat of formation of 8·6 cals., whilst the crystalline variety has a heat of formation of 14·2 cals., so that a difference of 0·33 volt is introduced between their respective decomposition voltages. It is shown that heats of solution of insoluble salts can be calculated, the results adding force to the law stating that solubility is largely determined by the mutual affinity of the solvent and solute as represented by the heat of solution. T. H. P.

2378. *Dissociation by Means of the Alternating Electric Current.* **W. H. Davis.** (Amer. Electrochem. Soc., Trans. 5. pp. 241–243, 1904.)—It was not found possible by means of a direct current satisfactorily to regenerate cyanide liquors that had largely become saturated with heavy metals. A satisfactory result was, however, obtained by using an alternating current. The current used was derived from a three-phase generator working at 60 cycles per sec., one leg of the circuit being connected to the electrolytic cell and the current controlled by a bank of incandescent lamps. Under these conditions it was possible largely to remove the heavy metals as oxides from a solution containing free alkali, and in actual practice a considerable increase in the concentration of free cyanide was produced. T. M. L.

2379. *Combinations of Cerium.* **J. Sterba.** (Annal. Chim. Phys. 2. pp. 193–232, June, 1904.)—Since the discovery of A. v. Welsbach the chemistry of certain rare metals has become of practical importance. The research deals with (1) The preparation and purification of oxide of cerium. This is the starting-point. The process of Wyrouboff and Verneuil is found to be the best. A solution of the mineral cerite is precipitated by ammonia in presence of hydroxyl. The cerium and other metals comes down in the form of hydrates. On boiling, $CeO_3 3H_2O$ is produced, and the hydrates of the other metals are reduced to ordinary hydrates. When the precipitate is dissolved in nitric acid, $Ce(NO_3)_4$ and the nitrates of the other earths $R(NO_3)_3$, as well as $Th(NO_3)_4$ if thorium be present. By treatment with ammonium nitrate a basic nitrate of cerium is separated which is free from the other metals with the exception of thorium, which requires a special method for its separation. The nitrate is washed and calcined and gives a perfectly white oxide. If it is required to be oxidised this may conveniently be done by electrolysis. The solution acidified with nitric acid is placed in a platinum basin, which is made the anode, an ordinary electrode serving as a kathode. With 0·5–0·7 amp. at 2 volts the oxidation is complete in three hours. A basic nitrate may then be precipitated by the addition of ammonium sulphate. Details are given of the necessary processes to ensure success. To obtain a pure product it is necessary to repeat the operations a number of times. (2) Preparation of ceric oxide and certain of its salts. (3) Manufacture of crystallised oxide of cerium. (4) Preparation of pure cerous oxide. (5) Preparation and properties of cerium sulphide. (6) Preparation of $2CeO_2$, CeC_2 in an electric furnace. This oxycarbide is relatively stable, but by continued action of the heat of the furnace it is transformed to CeC_2. (7) Preparation of $CeSi_2$ in the electric furnace. This is analogous to CeC_2, but much less attacked by the various reagents. W. W. H. G.

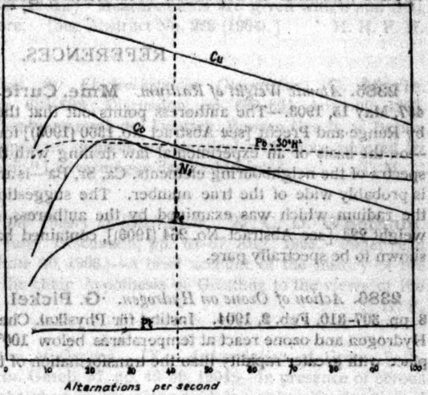
2380. *Silver Voltameters.* **K. E. Guthe.** (Phys. Rev. 18. pp. 445–447, June, 1904. Abstract of paper read before the Amer. Physical Society, April 22, 1904.)—A severe test of different forms of the instrument shows that the Richards type is the only satisfactory one so far produced, the porous, fine-grained cup surrounding the anode preventing the anode liquid from reaching the kathode. Leduc's form, in which a mass of granulated silver enclosed by filter-paper is used as anode, does not prevent the formation of the complex disturbing ion, even with small anode current density, and the use of filter-paper should be avoided. The author has slightly modified the Richards form by placing finely-divided silver at the bottom of the cup, which effectually removes the complex ion, and avoids the necessity for frequently pipetting the anode liquid from the bottom of the cup, as in the original. He also proposes another form of voltameter in which granulated silver is placed in a layer about 0·5 cm. deep at the bottom of a large porous cup; upon this is pressed the silver plate forming the anode connection, and the whole is immersed in a platinum bowl containing neutral 20 per cent. solution of silver nitrate. With the original and modified Richards types and that devised by the author, very concordant results have been obtained; thus, assuming that the Clark cell has an e.m.f. of 1·434 volts at 15° C., the following values were found for the electrochemical equivalent of silver:—

Richards type..............................	1·11682 mgm. per coulomb.
Modified Richards type	1·11682 „ „ „
Large anode type	1·11683 „ „ „

Any one of these three types allows of a degree of accuracy unattainable with that now in common use. W. H. Sı.

2381. *Electrolytic Preparation of Bromoform.* **E. Müller** and **R. Loebe.** (Zeitschr. Elektrochem. 10. pp. 409–414, June 17, 1904. Communication from the Elektrochem. Laborat. der K. Sächs. Techn. Hochschule, Dresden.)—Using a diaphragm and gradually adding carbonate to the solution, Coughlin obtained a 100 per cent. yield of bromoform from potassium bromide and acetone by electrolysis. Using no diaphragm, the authors find that smaller yields than this are obtained. The percentage of the current-work employed in the reduction increases with the duration of the experiment, so that substances formed during the electrolysis, and even the acetone itself, undergo reduction; addition of 0·2–0·3 per cent. of potassium chromate diminishes the reduction. Electrolysing a mixture of 500 c.cm. of 25 per cent. potassium bromide solution, 50 c.cm. of acetone, and 1 gm. of potassium chromate with a current density of about 0·03 amp. per sq. cm. between platinum electrodes, and passing carbon dioxide through the solution, yields of 60–80 per cent. are obtained if the formation of brom-bromoform is not aimed at. The latter is obtained with a vigorous current of carbon dioxide, and is decomposed after the electrolysis by soda solution containing acetone. The process is simpler and more economical than when a diaphragm is used. After subtracting the loss of oxygen due to evolution of gas and formation of bromate, there still remains an unexplained loss of current, which can only partly bring about the oxidation of the acetone and the formation of bromacetone. Such losses occur also when a diaphragm is used if the formation of brombromoform is not aimed at. **T. H. P.**

2382. *Influence of Frequency in Electrolysis with Alternating Currents.* **A. Brochet** and **J. Petit.** (Comptes Rendus, 138. pp. 1421–1423, June 6, 1904.)—Certain metals which are almost insoluble in potassium cyanide, dissolved when submitted to the action of an alternating electromotive force. In the case of copper there is a rapid decrease in the rate of dissolution as the frequency rises, but in the case of platinum there is a slight increase, and nickel, cobalt and iron show a maximum rate of dissolution at a frequency of 10 to 30 alternations per sec. These results are clearly indicated in the accompanying curves. [See also Abstract No. 1844 (1904).] **T. M. L.**



2383. *Electrolytic Estimation of Tellurium.* **G. Gallo.** (Accad. Lincei, Atti, 13. pp. 713–723, June 19, 1904.)—The tellurium is dissolved in concentrated sulphuric acid in a capsule, and heated until the red colour disappears and white fumes commence to be evolved. After allowing to cool, a few c.cm. of boiled water cooled in a current of carbon dioxide are carefully added, and then 100–150 c.cm. of a 10 per cent. solution of sodium pyrophosphate previously boiled and also cooled in a current of carbon dioxide. Heat is then gently applied, stirring with a glass rod, till solution is complete and the temperature reaches 60–62°, at which it is maintained. Electrolysis is now started, using as anode a platinum spiral, and employing a current density of 0·025 amp. and a p.d. between the electrodes of 1·8–2 volts. Completion of the electrolysis is ascertained by warming 1 or 2 c.cm. of the liquid with a few drops of HCl and a little $SnCl_2$, when if no brown liquid colour is produced, all the metal has been deposited. When this point is reached the liquid is decanted from the capsule and the contents washed with boiled water, or, better, with a solution of SO_2, and then with alcohol. It is dried for 10 min. at 100°, followed by 2 hours in a desiccator *in vacuo*, and finally weighed. By this method about 25 mgm. of tellurium are deposited in an hour, and alteration of the deposit is avoided. The largest amount obtained was 0·408 gm. in 17 hours, but this could probably be considerably exceeded. **W. H. Si.**

2384. *Electrolytic Separation of Nickel and Zinc.* **Hollard and Bertiaux.** (Comptes Rendus, 138. p. 1605, June 20, 1904.)—Having shown that the electrolytic separation of nickel from zinc can be effected in baths whose electric resistance is reduced in two ways [see Abstracts Nos. 455 and 687 (1904)], the authors announce that zinc ammonium nitrite gives only complex ions and is not precipitated by the current. The sulphates of the metals are mixed with magnesium and ammonium sulphates, sulphuric acid and ammonium nitrate, and with a saturated solution of SO_2; after boiling, ammonia is added, when electrolysis with currents of 1 amp. at 85° C. precipitates in a few hours, from 0·2530 to 0·2547 gm. Ni of the 0·2552 gm. applied; no zinc is deposited even when 1 gm. Zn is in solution. H. B.

REFERENCES.

2385. *Atomic Weight of Radium.* **Mme. Curie.** (Phys. Zeitschr. 4. pp. 456–457, May 15, 1903.—The authoress points out that the value, 258, which was given by Runge and Precht [see Abstract No. 1360 (1903)] for the atomic weight of radium—on the basis of an experimental law dealing with the distribution of lines in the spectra of the neighbouring elements, Ca, Sr, Ba—is arrived at by extrapolation, and is probably wide of the true number. The suggestion of Runge and Precht that the radium which was examined by the authoress, and which gave the atomic weight 224 [see Abstract No. 264 (1903)], contained barium is untenable, as it was shown to be spectrally pure. T. H. P.

2386. *Action of Ozone on Hydrogen.* **G. Pickel.** (Zeitschr. Anorg. Chem. 38. 3. pp. 307–310, Feb. 2, 1904. Institut für Physikal. Chemie, Göttingen, July, 1903.)—Hydrogen and ozone react at temperatures below 100°, and the combination takes place with greater rapidity than the transformation of the ozone into oxygen. T. H. P.

2387. *Slow Oxidation of Methane at Low Temperatures.* II. **W. A. Bone** and **R. V. Wheeler.** (Chem. Soc., Journ. 83. and 84. pp. 1074–1087, Aug., 1903.)—The authors describe further experiments confirming the results previously obtained by them [see Abstract No. 2278 (1902)], and showing further that formaldehyde is an intermediate product in the slow combustion of methane at 450–500°. The reactions taking place are: $CH_4 + O_2 = CH_2O + H_2O$; $CH_2O + O_2 = CO_2 + H_2O$ and $2CH_2O + O_2 = 2CO + H_2O$. T. H. P.

2388. *Transformation of Aldehydes and Ketones into Alcohols by Catalytic Hydrogenation.* **P. Sabatier** and **J. B. Senderens.** (Comptes Rendus, 137. pp. 301–303, Aug. 3, 1903.)—The best reagent for bringing about the reduction of aldehydes and ketones to alcohols by means of hydrogen is nickel reduced at as low a temperature as possible. Thus, acetaldehyde vapour, when passed with hydrogen over reduced nickel at 140°, gives an almost theoretical yield of ethyl alcohol. With other aldehydes and with ketones the optimum temperatures have different values. Reduced cobalt has a less energetic action than the nickel, and the yield of alcohol is smaller. Reduced copper acts only at a high temperature, so that much of the alcohol formed undergoes decomposition. With platinum sponge the action is so slow and the reduction so incomplete as to make its use impracticable. T. H. P.

2389. *Radio-activity and Atomic Weight of Tellurium.* **G. Pellini.** (Gazzetta Chim. Ital. 33. 2. pp. 35–42, 1903.)—The author suggests that the explanation of the fact that tellurium gives a higher atomic weight than iodine, and so makes these elements occupy abnormal positions in the periodic system of the elements, is due to the presence in the tellurium of a small quantity of an element which has a higher atomic weight (about 212), is similar to tellurium, and analogous to the radio-active constituents of pitch-blende. [See Marckwald, Abstract No. 429 (1903).] T. H. P.

2390. *Molecular Weight Determination at Very High Temperatures.* **W. Nernst.** (Zeitschr. Elektrochem. 9. pp. 622–627; Discussion, pp. 627–628, Aug. 6, 1903. Paper read before the 10 Hauptversamml. der Deutsch. Bunsen Gesell., at Berlin, June 3–8, 1903.)—A small Meyer's apparatus made of iridium is used, giving a volume of air to be measured of about 0·13 c.cm. To weigh the small quantities of substance a special torsion balance accurate to 2 mgm. is used. The oven is heated electrically, and the temperature determined after the method of the optical pyrometer. [See Abstract No. 2122 (1901).] Measurements are given with S and SO_2, in addition to those given before. [See Abstract No. 222 (1904).] H. H. F. H.

2391. *On Uniform Symbols for Electrochemical Quantities.* **C. Marie.** (Zeitschr. Elektrochem. 9. pp. 686–688; Discussion, pp. 688–691, Aug. 20, 1903. Report read before the 10 Hauptversamml. der Deutsch. Bunsen Gesell., at Berlin, June 3–8, 1903.)—The more important symbols are identical with those adopted by Kohlrausch and Holborn in their "Leitvermögen der Elektrolyte." T. M. L.

2392. *Present Position of the Theory of Electrolysis.* **W. C. D. Whetham.** (Electro-Chemist, 3. pp. 9–21, July; Discussion, pp. 64–67, Aug., 1903. Paper read before the Faraday Society, June 30, 1903.)—A brief account of the history of the theories of electrolysis, from the chain hypothesis of Grotthus to the views of the present day. T. H. P.

2393. *The Rendering Active of Oxygen.* IX. *Autoxidation of Cerous Salts.* **C. Engler.** (Ber. Deut. Chem. Gesell. 37. pp. 49–59, 1904.)—In presence of cerous salts, atmospheric oxygen is absorbed by arsenious acid, but only a single atom of oxygen is rendered active by a single atom of cerium, whilst Baur [see Abstract No. 2322 (1904)] found that 1·5 atoms were. The difference is not due to side-actions, as the experiments were carried out very rapidly, especially when cerous chloride was used in place of the sulphate. T. M. L.

2394. *Chemical Properties of Radium.* **O. Rebuffat.** (Atti dell' Assoc. Elettr. Ital. 8. pp. 177–183, March–April, 1904. Paper read before the Meeting of the A.E.I. at Naples, March 26, 1904.)—A summary of the preparation and properties of radium, polonium, and actinium. W. H. Si.

2395. *International Atomic Weights.* **J. Sakurai** and **K. Ikeda.** (Chem. News, 89. p. 305, June 24, 1904. From the Journal of the Tokyo Chemical Society, April, 1904.)—The authors criticise the use of two standards—the hydrogen and oxygen—in the tables published by the Sub-committee on International Atomic Weights. Further, while in the list of atomic weights with reference to oxygen as 16, only so many figures are given that the last one may be taken as correct, in the other table certain values (those for iodine, lead, and silver) are given to 5 figures, although that for oxygen is given as 15·88. The atomic weight of phosphorus, which the report states "has been peculiarly neglected," is given as 31·0 (O = 16) and 30·77 (H = 1). Other minor discrepancies are also indicated. T. H. P.

2396. *Complexity of Thorium.* **C. Baskerville.** (Science, 19. p. 893, June 10, 1904.)—The author refers to his methods of showing the complexity of thorium and obtaining from it two new elements. J. J. S.

2397. *Action of Vapours from Certain Hydrocarbon Compounds on Microbes and Insects.* **Berthelot.** (Annal. Chim. Phys. 2. pp. 181–185, June, 1904.)—The author confirms the efficacy of many of the hydrocarbons which are commonly employed for this purpose, but finds that those of the order of naphthalene have little or no microbicidal or insecticidal action. He discusses the behaviour of certain oxidising and reducing agents which in very small quantities produce a continuous effect without loss of substance. H. W. P. Y.

2398. *Formaldehyde in Combustion Products and Smoke.* **A. Trillat.** (Comptes Rendus, 138. pp. 1613–1615, June 20, 1904.)—Substances such as coal, peat, several sorts of wood, paper, pure cellulose, cork, indiarubber, various fabrics, and tobacco were burnt in a glass tube, and the products tested for formaldehyde with dimethylaniline. In all cases formaldehyde was found in amounts varying from 1/10,000 to 1/100,000 of the weight of substance burnt. Substances containing cellulose gave the most formaldehyde. Aromatic hydrocarbons gave similar amounts, The quantity can be greatly increased by burning the hydrocarbon in a tube filled with copper turnings. These and other experiments show that formaldehyde can be regarded as a normal product of industrial combustion, thus accounting for its presence in the atmosphere of towns. [See Abstract No. 735 (1904).] F. S.

2399. *Nitrate and Nitrite of Thallium.* **U. Thomas.** (Comptes Rendus, 138. pp. 1697–1699, June 27, 1904.)—The decomposition products obtained when thallium nitrate is heated to about 450° consist of nitrous anhydride and thallium sesquioxide, without any appreciable quantity of nitrite, in the latter respect differing from the alkaline nitrates. When the nitrite is heated it breaks up into nitrous anhydride and thallium oxide. It is noteworthy that distinct quantities of the nitrate distil unaltered at a temperature of about 300°. W. H. Si.

2400. *Yellow and Red Thallium Iodides, and Normal Temperature of their Reciprocal Transformation.* **D. Gernez.** (Comptes Rendus, 138. pp. 1695–1697, June 27, 1904.)—It is found that the yellow and red modifications of thallium iodide can coexist at temperatures between −192° and +200°, both merely becoming darker as the temperature is raised. To bring about the change it is necessary to touch the yellow modification with a particle of the red iodide, and by this means the temperature of transformation is shown to be 168°, which is 22° below that found by Hebberling. W. H. Si.

2401. *Difference in Behaviour of Red and Yellow Mercuric Oxides.* **W. Müller-Erzbach.** (Phys. Zeitschr. 4. pp. 517–518, July 1, 1903.)—Red mercuric oxide is reduced in hydrogen at 230°, the action at 220° being very slight. The yellow oxide, obtained by adding the nitrate to excess of potassium hydroxide solution, is, on the other hand, reduced to metal when heated in hydrogen at 127°. This difference in behaviour indicates a considerable difference between the two oxides. Confirmation of this is given by the electrical behaviour of the two oxides and by their solubility in water at 100°. T. H. P.

2402. *Solvent Action and Electrical Conductivity of Liquid Nickel Carbonyl.* **A. Mittasch.** (Zeitschr. Phys. Chem. 46. pp. 37–42, 1903. Physik. Chem. Institut, Leipzig.)—The author has tested the solvent action of liquid nickel carbonyl on a number of inorganic and organic substances, but finds that it has in general very little solvent power. It was not found to possess any ionising power in the case of the very few substances which dissolved slightly in it. A few organic non-electrolytes, *e.g.*, camphor and alcohol, have a somewhat greater solubility in liquid nickel carbonyl. [See also Abstract No. 1733 (1902).] A. F.

2403. *Theory of Suspensions and the Electric Double Layer.* **J. Billitzer.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2a. pp. 1098–1106, July, 1903.)—The author discusses the nature of colloids and explains the theories which have been advanced, more especially with reference to the action of electrolytes in bringing about the coagulation of colloids and the flocculation of suspended matter. Helmholtz's assumption of an electric double layer at the surface of the liquid and the suspended matter leads to certain difficulties, which the author avoids by ascribing the ordinary electromotive solution tension to all suspended solid matter. This suspended matter assumes a charge and becomes precipitated by tearing off from the added electrolyte an oppositely charged ion, which acts as a condensation nucleus. One ion serves as the nucleus for many parts of the colloid. [See also Abstracts Nos. 148 and 197 (1904).] T. H. P.

2404. *Hydrolysis of Trisaccharide by Weak Acids.* **A. Wogrinz.** (Zeitschr. Phys. Chem. 44. pp. 571–574, Aug. 4, 1903.)—Equations are developed on the supposition that dissociation gives monosaccharides and that there are side reactions. H. H. F. H.

2405. *Molecular Compounds with Iodine.* **D. Strömholm.** (Zeitschr. Phys. Chem. 44. pp. 721–732, Aug. 18, 1903. Upsala Universitätslaboratorium.)—By the solution method already used by the author [see Abstract No. 1547 (1904)] to study molecular compounds of mercuric chloride and water, a search has been made for evidence of the formation of additive compounds of iodine. It appears that the solvents which give brown iodine solutions, viz., water, alcohol, and ether, yield addition compounds with iodine. Solvents which furnish violet (carbon bisulphide) or red (benzene and chloroform) iodine solutions do not yield such addition compounds. D. H. J.

2406. *Chemico-Physical Properties of Malates of Alkaline Earths.* **L. Cantoni** and **Veratietti.** (Gazzetta Chim. Ital. 33. 2. pp. 139–145, 1903.)—The authors have made a number of experiments on the separation of barium, calcium, and strontium malates from solutions in presence of ammonia. Three principal factors are found to come into play, namely, the concentration, temperature, and nature of the solution. The method of preparation employed is expressed by the equation—

$$MCl_2 + C_4H_6O_5 + 2NH_3 = 2NH_4Cl + C_4H_4O_5M,$$

M being the alkaline earth metal. The results obtained are tabulated. T. H. P.

2407. *Synthesis of Indigo and its Methyl Derivatives.* **M. Kuhara** and **M. Chikashige.** (Coll. Sci. and Engin., Mem. Kyōto, I. 1. pp. 1–19, 1903.)—In addition to the ordinary physical data for the synthesised substances, tables of solubilities and of absorptivities are given. D. H. J.

2408. *Amphoteric Character of Cacodylic Acid.* **J. Zawidski.** (Ber. Deut. Chem. Gesell. 36. pp. 3325–3337, 1903.)—The author concludes that cacodylic acid is an exceedingly feeble acid, but that with strong bases it can form salts showing practically no hydrolysis. This would class it as a pseudo-acid; and since it is also an amphoteric electrolyte, it is held that the characteristics of pseudo-acids can also occur with amphoteric electrolytes. L. H. W.

2409. *Preparation of Pure Cerium Dioxide and its Reduction by Hydrogen.* **R. J. Meyer.** (Zeitschr. Anorg. Chem. 37. 3. pp. 378–393, Nov. 30, 1903. Wissenschaftlich Chemisches Laboratorium, Berlin.)—The author describes the preparation of pure cerium dioxide, and finds that it can be reduced in a current of hydrogen to a lower oxide. It is stated that cerium sesquioxide does not exist. A. F.

2410. *Amphoteric Electrolytes, and especially Cacodylic Acid.* **A. Hantzsch.** (Ber. Deut. Chem. Gesell. 37. pp. 1076–1084, 1904.) Zawidski [see Abstract No. 2408 (1904)] considered sodium cacodylate to be abnormal because its hydrolysis was not of the same order as that of sodium carbonate. The author now points out that if the comparison is made with primary sodium carbonate the abnormality disappears. The assumption of Zawidski that absence of hydrolysis may occur with amphoteric electrolytes is therefore unfounded. L. H. W.

2411. *Colour Reactions of Molybdic Acid.* **M. E. Pozzi-Escot.** (Comptes Rendus, 138. p. 200, Jan. 25, 1904.)—The addition of tannin to a solution of molybdic acid yields an orange to red colouration in concentrated solution and a yellow colouration in dilute solution, by which the presence of one part in 100,000 can be detected. Gallic and pyrogallic acids behave in a similar manner. The colour is not affected by boiling, and even in concentrated solution no precipitate is formed. Iron, unless present in large excess, gives no reaction with tannin in presence of molybdenum. T. M. L.

2412. *Leiden Cryogenic Laboratory.* **H. H. F. Hyndman.** (Nature, 69. pp. 259–261, Jan. 14, 1904. Engineering, 77. pp. 323–326, March 4, and pp. 349–350, March 11, 1904.)—A short account of the equipment, and of the work carried out in Kamerlingh Onnes' celebrated cryogenic laboratory at the University of Leiden. A list is also given of the principal researches which have been carried out there. As is well known, these researches are published in English in the "Communications from the Physical Laboratory at Leiden," and the latter are sent gratis to any scientific man who wishes for them. The subjects embraced extend from thermodynamical researches on the critical states and condensation-phenomena of binary gaseous systems to investigations on magneto-optical and magneto-electrical phenomena. [See also Abstracts Nos. 772, 1524, and 1529 (1903).] F. G. D.

2413. *Constant-standard Silver Trial Plates.* **E. Matthey.** (Roy. Soc., Proc. 73. pp. 124–127, March 7, 1904.)—It appears that considerable difficulties have been experienced with regard to obtaining large sterling silver plates of a constant standard. The author has overcome this difficulty, having obtained very concordant results. Diagrams are given illustrating the efficiency obtained. O. J. S.

2414. *Hydrolysis of Casein.* **Z. H. Skraup.** (Ber. Deut. Chem. Gesell. 37. pp. 1596–1597, 1904.)—The author has separated from the products of the hydrolysis of casein several hydroxyamino acids, including caseic acid. This occurs in two modifications, one melting at 226° C. and feebly dextro-rotatory, the other melting at 246° C. and optically inactive. Both seem to yield the same copper salt and hydrochloride. L. H. W.

2415. *Thorium in Ceylon.* **W. Dunstan.** (Nature, 69. pp. 510–511, March 31, 1904. Imperial Institute, March 29.)—An account of a new mineral found in Ceylon, which exists in small black cubical crystals, is radio-active and is rich in thoria. **W. Ramsay.** (Nature, 69. pp. 533–534, April 7, and p. 559, April 14, 1904.)—The mineral referred to is found to give off helium when heated. Ramsay considers from its behaviour when analysed that it contains very little thorium, and suggests the presence of an unknown tetravalent element. The second reference is a note modifying the statement that the mineral contains only an insignificant amount of thorium. Its chemical behaviour seems to indicate the presence of unknown elements of higher atomic weight than thorium. **T. A. Henry.** (Nature, 69. pp. 559–560, April 14, 1904.)—Henry brings forward observations to support the view that the mineral examined contains thoria in large quantity. J. J. S.

2416. *Coagulation of Colloidal Solutions.* **J. Duclaux.** (Comptes Rendus, 138. pp. 809–810, March 28, 1904.)—When a solution of colloidal ferric hydroxide (really ferric hydroxy-chloride, $Fe_2(OH)_mCl_n$) is precipitated by means of potassium sulphate solution, the precipitate has a variable composition represented by $Fe_2(OH)_m(SO_4)_pCl_{n-2p}$. One atom of chlorine is replaced by half a molecule of sulphuric acid, but only by more than 20 molecules of nitric acid. The coagulation of a colloid is a consequence of the change in its chemical composition. T. H. P.

2417. *Factors of Equilibrium, Capillary Pressure and Weight.* **A. Ponsot.** (Comptes Rendus, 138. pp. 803–806, March 28, 1904.)—It is first pointed out that if we take capillary phenomena into consideration we must introduce a new variable, say the radius of curvature of spherules of one phase immersed in another, and hence increase the variance by 1—a fact which is perfectly obvious and well known. In the second half of the paper the author considers a system of phases piled one on the other and placed in a gravitational field, the varying value of g being taken into consideration. The conclusion is arrived at that the variance of such a system is $n+2$, there being n independent components. F. G. D.

2418. *Osmosis.* **A. Guillemin.** (Comptes Rendus, 138. pp. 802–803, March 28, 1904.)—The author replies to Ponsot [see Abstract No. 1853 (1904)]. Discussion of the mechanism whereby liquids traverse semipermeable walls. In contradistinction to Ponsot, who regards the liquid as passing through in the state of gas, Guillemin considers it to form a solid dissociable compound, and likens the case to that of hydrogen passing through palladium. F. G. D.

2419. *Institute of Physical- and Electro-Chemistry at the Karlsruhe Hochschule.* **M. le Blanc.** (Zeitschr. Elektrochem. 10. pp. 238–242, April 8, 1904.)—An account of the origin of the Institute and equipment of the laboratories.

2420. *Apparent Diminution of the Energy of a Feeble Acid in Presence of a Neutral Salt of this Acid.* **G. Chesneau.** (Comptes Rendus, 138. pp. 968–970, April 18, 1904.)—The author thinks it unnecessary to appeal to the ionic theory to explain such reactions as the precipitation of nickel sulphide from an acetic acid solution of nickel acetate by hydrogen sulphide when sodium acetate is added to the solution. According to the author the real reason is the formation of some alkaline sulphide by the action of the H_2S on the alkaline acetate, which explanation he supports by showing that sodium nitroprusside gives a colouration with a solution of sodium acetate to which H_2S-water has been added, even in the presence of acetic acid. The author has therefore demonstrated to himself that under such conditions there is a sensible production of the sulphur ion (or sulphydric ion). But that is just what the ionic theory says! F. G. D.

2421. *Decomposition of Hydrogen Dioxide under the Influence of Radium Bromide.* **H. J. H. Fenton.** (Cambridge Phil. Soc., Proc. 12. pp. 424–426, April, 1904.)—The (spontaneous) decomposition of hydrogen dioxide in dilute aqueous solutions appears to be slightly accelerated by the proximity of radium bromide. Experiments were made both with glass flasks and with flasks coated with paraffin. T. M. L.

2422. *Electrolysis of Tetra-ethylammonium Iodide.* **E. Goecke.** (Zeitschr. Elektrochem. 10. p. 249, April 15, 1904. Chemisches Universitätsinstitut, Bonn.)—On electrolysing a 10 per cent. aqueous solution of tetra-ethylammonium iodide with an anode current density of 0·1, tetra-ethylammonium tri-iodide and a little iodoform are obtained at the anode. The yield of the former compound is good, but raising the temperature and current strength favours the formation of iodoform. T. H. P.

2423. *Elements and Compounds.* **W. Ostwald.** (Chem. Soc. Journ. 85-86. pp. 506-522, April, 1904. Nature, 70. pp. 15-20, May 5, 1904. Faraday Lecture.)

2424. *Nuclei Produced by the Mixture of Coal Gas and Air.* **C. Barus.** (Phys. Rev. 16. p. 385, June, 1903. Paper read before the American Physical Society, April 25, 1903.)—While coal gas and filtered air when separate are free from nuclei, when they are *mixed* and then examined by aid of coronas, nuclei are abundantly present to the extent of 2,000 to 3,000 per cub. cm., showing that chemical reaction (attributable to the presence of sulphur gas as an impurity) has taken place. J. J. S.

2425. *Solubility of Homogeneous Mixtures and Mixed Depolarisers.* **A. Thiel.** (Zeitschr. Phys. Chem. 43. pp. 641-670, May 22, 1903. Chem. Inst. der Bergakademie, Clausthal, Nov., 1902.)—Fourteen possible cases are discussed with reference to the behaviour of isomorphous mixtures towards solvents, and the majority of these are illustrated by actual cases. T. M. L.

2426. *Mixtures of Iodine and Sulphur.* **R. Boulouch.** (Comptes Rendus, 136. pp. 1577-1578, June 22, 1903.)—By means of dilatometer experiments it is shown that (1) sulphur and iodine when fused together do not form definite compounds or solid solutions; (2) they form a eutectic containing 0·543 sulphur and 0·457 iodine, which melts at 65·5° C. T. M. L.

2427. *Production of Diamonds from Molten Silicates.* **R. v. Hasslinger** and **J. Wolf.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2b. pp. 507-521, July, 1903.)—A record of 34 different experiments in which various proportions of K_2O, Na_2O, BaO, CaO, MgO, ZnO, PbO, Al_2O_3, Fe_2O_3, R_2O_3, SiO_2, TiO_2, and B_2O_3 were heated to a temperature of about 1,400° C., either in a porcelain furnace or by the use of thermit. The proportions were selected to correspond with the matrix with which diamonds associate. The actual mixtures used contained K_2CO_3, KNO_3, Swedish felspar, Na_2CO_3, $BaCO_3$, $CaCO_3$, $MgCO_3$, Pb_2O_3, ZnO, $B(OH)_3$, rutile, sand, Al_2O_3, Fe_2O_3, CaC_2, and graphite. The mass on cooling was found in most cases to include carbon in the form of diamond. No details are given of the size of the crystals so obtained. [See also Abstract No. 529 (1903).] W. W. H. G.

2428. *Atomic Weight Determinations Published during* 1903. **F. W. Clarke.** (Chem. News, 89. p. 164, March 31, and pp. 173-175, April 8, 1904. From the Journal of the American Chemical Society, 26, No. 3.)—A short account of new atomic weight determinations as given in the Eleventh Annual Report of the Committee on Atomic Weights. T. H. P.

2429. *Preparation of Samaria and Atomic Weight of Samarium.* **G. Urbain** and **H. Lacombe.** (Comptes Rendus, 138. pp. 1166-1168, May 9, 1904.)—The authors describe the preparation, by the method previously given by them, of 150 gm. of perfectly pure samarium oxide. The atomic weight of samarium is found to be very near to 150·34 (O = 16). T. H. P.

2430. *Radium and Milk.* **W. Ackroyd.** (Nature, 70. p. 55, May 19, 1904.)—In the souring of milk the amount of lactic acid developed may reach 0·80 per cent. in three or four days, when the milk solidifies. In view of Lodge's suggestion (Nature, Oct. 1, 1903), comparisons were made by the author of the rate of acidification, in two or three days, with and without the influence of radium rays from a 5 m.gm. radium bromide tube. The differences in five cases did not exceed the limit of experimental error, 0·01 per cent. of lactic acid, and in a sixth case, with the milk solidified, the difference only amounted to 0·05 per cent. of lactic acid. It seems, therefore, that under normal conditions radium rays have little or no effect on the functions of the lactic acid bacillus. T. H. P.

2431. *Some Binary Compounds of Uranium.* **A. Colani.** (Comptes Rendus, 137. pp. 382–384, Aug. 10, 1903.)—The author has prepared the sulphide, US; the selenide, USe and U_4Se_3; the telluride, U_4Te_3; the nitride, U_3N_3; the phosphide, U_3P_2; the arsenide, U_3As_2; and the antimonide, U_3Sb_2 of uranium. The general method was to heat the double chloride UCl_2, NaCl in a current of the appropriate hydrogen compound of the non-metal at about 500–1,000°. These compounds do not burn easily in the air, but when projected into the Bunsen flame yield bright sparks. They are all violently attacked by concentrated nitric acid. A. F.

2432. *Production of Silicides.* **P. Lebeau.** (Zeitschr. Elektrochem. 9. pp. 641–642, Aug. 6, 1903. Report read before the 10 Hauptversamml. d. Deutschen Bunsen Gesellschaft f. angew. physik. Chemie (Section 10), June 3–8, 1903.)—The formation of a large number of silicides [see Abstract No. 1283 (1903)] has been studied by the author. He has now succeeded—using the method described in the Abstract to which reference has just been made—in obtaining a number of definite silicides of Fe, Co, Mn, and Cr: $SiFe_2$, SiFe, Si_2Fe, $SiCo_2$, SiCo, Si_2Co, $SiMn_2$, SiMn, Si_2Mn, $SiCr_3$, $SiCr_2$, Si_2Cr_3, and Si_2Cr. W. W. H. G.

2433. *Crystalline Form of* $BaSiO_3 . 6H_2O$. **F. M. Jaeger.** (Zeitschr. Anorg. Chem. 36. 3. pp. 400–402, Sept. 16, 1903. Anorg. Chem. Lab. der Universität, Leiden, July, 1903.)—Notes of a crystallographic investigation of the salt $BaSiO_3$ $6H_2O$. It belongs to the rhombic system, the symmetry being that of the rhombic-bipyramidal class. F. G. D.

2434. *Stability of Salts with Oxidisable Ions.* **R. Abegg.** (Zeitschr. Elektrochem. 9. pp. 569–572, July 9, 1903.)—This paper is not novel. Similar work has been published by Abel (Zeitschr. f. anorg. Chem. 26, 361, 1901). F. S.

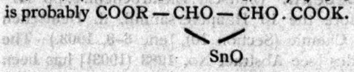
2435. *A Double Carbide of Chromium and Tungsten.* **H. Moissan** and **A. Kouznetzow.** (Comptes Rendus, 137. pp. 292–295, Aug. 3, 1903.)—By two different methods the authors prepared samples agreeing with the formula W_2C, $3Cr_3C_2$; by heating together in the electric furnace, in one case sesquioxide of chromium, tungstic acid, and carbon; in the other, metallic chromium and tungsten with a small quantity of carbon and an excess of copper. This double carbide is very stable, not being attacked by the ordinary acids and reagents; it is exceedingly hard and non-magnetic. The solvent used by the authors was a mixture of carbonate and nitrate of sodium. F. R.

2436. *Action of Ammonia on Copper Sulphate Solutions.* **J. Locke** and **J. Forssall.** (Amer. Chem. Journ. 31. pp. 268–298, 1904.)—The authors determined the lowering of the vapour pressure of a solution of ammonia, produced by adding copper sulphate, by a modification of Gaus's method. As a result it is found that in dilute solutions only one complex, $Cu(NH_3)_4$, is formed, the whole of the copper in solution practically passing into this form. With higher concentrations of ammonia a small quantity of a complex, $Cu(NH_3)_5$ is produced, which amounts in approximate normal solutions to about 3 per cent. of the total copper present. L. H. W.

2437. *Hydrates of Nitric Acid.* **F. W. Küster.** (Chem. Zeit. 28. pp. 132–135, 1904. Soc. Chem. Ind., Journ. 23. pp. 251–252, March 15, 1904. Abstract.)—An examination of the freezing-points of nitric acids of gradually increasing strengths (made by Kremann in reinvestigation of Erdmann's work) showed that two maxima exist corresponding to the hydrates $HNO_3 . 3H_2O$ and $HNO_3 . H_2O$, and three minima indicating cryohydrates. The two hydrates exist in both the solid and the liquid form, the trihydrate being the more stable. None of the compounds mentioned by Erdmann were found. L. H. W.

2438. *Bibliography of the Colloids.* **A. Müller.** (Zeitschr. Anorg. Chem. 39. 2. pp. 121–151, April 2, 1904. Techn. Hochschule, Wien.)—The German titles to 356 papers are given, with a separate classification under a subject index.

2439. *Some Complex Salts of Tetravalent Tin.* **A. Rosenheim** and **H. Aron.** (Zeitschr. Anorg. Chem. 39. 2. pp. 170–174, April 2, 1904. Wissenschaftlich.-chem. Laboratorium, Berlin, Feb. 11, 1904.)—The author has prepared the pyridine salt of hydrostanni-iodic acid, $(C_6H_5N)_2 . H_2SnI_6$, and the quinoline salt, $(C_9H_7N)_2 . H_2SnI_6$. Also the sodium and potassium stannitartrates, $K_2(SnO)C_4H_2O_6 . 5H_2O$ and $Na_2(SnO)C_4H_2O_6 . 5H_2O$. The constitution of the latter is probably



$$\mathrm{COOR-}\underbrace{\mathrm{CHO-CHO}}_{\mathrm{SnO}}\mathrm{.\,COOK.}$$

A. F.

2440. *Hydrolytic Properties of the Seed of the Castor Oil Plant.* **E. Urbain** and **L. Saugon.** (Comptes Rendus, 138. pp. 1291–1292, May 24, 1904.)—It is shown that the cytoplasm can saccharify starch and invert cane-sugar as well as hydrolyse esters. It is further shown that these various hydrolytic actions can be effected simultaneously. F. G. D.

2441. *Relation of Mass Action and Physical Affinity to Toxicity.* **J. B. Dandeno.** (Amer. Journ. Sci. 17. pp. 437–458, June, 1904.)—The author has studied the concentrations of solutions of different salts at which growth of various seedlings ceases. The addition of sand diminishes the poisonous action. [In this paper the author condemns most frankly the application of the theory of electrolytic dissociation to physiological problems, believing that his experimental results, and those of others, are not in harmony with the theory. Judged by the theoretical discussion of results, however, the author shows himself ignorant of even the elements of the theory, nor does he appear to have heard of hydrolytic dissociation. The changes in concentration produced by absorption at the surface of finely divided solids, seem also to have escaped his notice. Whatever weaknesses the theory of electrolytic dissociation may have, the present indictment cannot be accepted as a very serious one.] A. F.

2442. *Ions and Ciliary Motion.* **R. S. Lillie.** (Amer. Journ. Physiol. 10. pp. 419–443, 1904.)—Solutions of sodium salts destroy cilia, but potassium and ammonium salts do not act so quickly; the action of sodium salts is unaffected by addition of other anions. Most kathions exhibit antitoxic action varying with the valency, the order in the heavy metal kathions being that of the metals in the solution-tension scale. The H ion shows marked antitoxic action in dilutions of N/6400 to N/12800. The amount of a given kathion needed to counteract the toxic effect of a salt increases rapidly with increase in valency of the anion of that salt.

L. H. W.

2443. *Theory of Electrolytic Dissociation.* **P. J. Beveridge.** (Chem. News, 89. p. 82, Feb. 12, 1904.)—In this letter the author points out that the results obtained by J. W. Richards (Chem. News, 89. p. 31, 1904) in his calculation of the heat of neutralisation of caustic soda by hydrochloric acid are purely accidental. Richards, in his calculations, determined the values for the particular concentrations used by Thomsen in his thermochemical experiments. If, however, he had taken other dilutions, *e.g.*, a solution ten times as dilute, the calculated values of the heat of neutralisation would not at all agree with the experimental, owing to the great change in osmotic pressure, there being a difference of as much as 3,000 calories. The author also points out that an ionised salt, such as potassium chloride, poses as two gas molecules and not as one in its osmotic pressure, whereas according to Richards it should only pose as one. T. S. P.